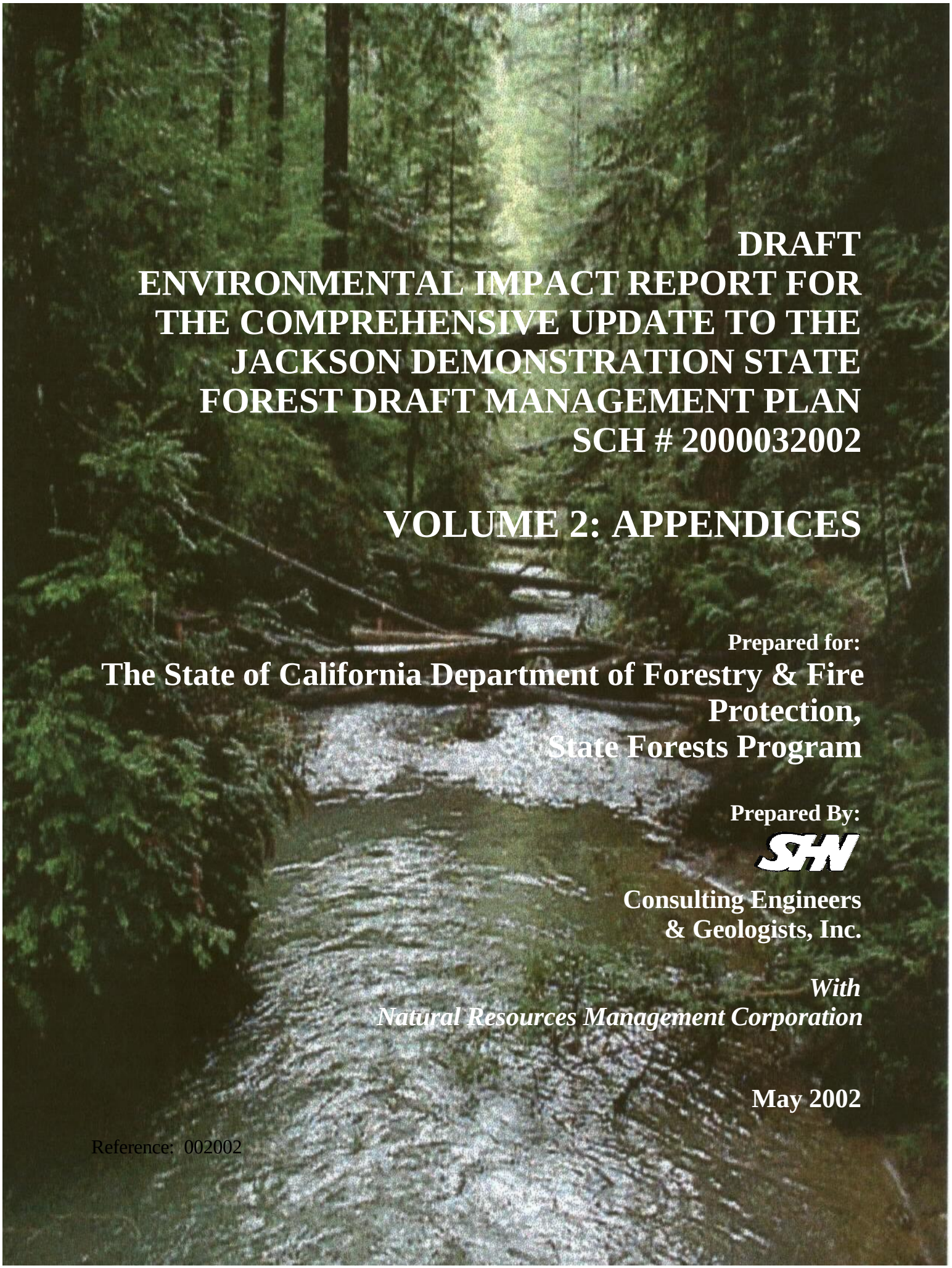

DRAFT ENVIRONMENTAL IMPACT REPORT FOR THE COMPREHENSIVE UPDATE TO THE JACKSON DEMONSTRATION STATE FOREST DRAFT MANAGEMENT PLAN SCH # 2000032002

VOLUME 2: APPENDICES

Prepared for:

The State of California Department of Forestry & Fire Protection,
State Forests Program

Prepared By:

Consulting Engineers & Geologists, Inc.

With
Natural Resources Management Corporation

May 2002

Reference: 002002

DRAFT
ENVIRONMENTAL IMPACT REPORT
FOR THE
COMPREHENSIVE UPDATE TO THE
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DRAFT MANAGEMENT PLAN
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Prepared for:

THE STATE OF CALIFORNIA DEPARTMENT OF FORESTRY & FIRE PROTECTION,
STATE FORESTS PROGRAM

Prepared By:

CONSULTING ENGINEERS & GEOLOGISTS, INC.
812 W. Wabash Ave.
Eureka, CA 95501-2138
707/441-8855

NATURAL RESOURCES MANAGEMENT CORPORATION
1434-3rd Street
Eureka, CA 95502-0682
707-442-1735

May 2002

(Cover photo by CH2MHill photographer, from the JDSF Draft Management Plan)

QA/QC: LDH

TABLE OF CONTENTS

APPENDICES

APPENDIX 1
ACRONYMS AND ABBREVIATIONS

ACHP	Advisory Council on Historic Preservation
ACOE	U.S. Army Corps of Engineers
ADA	Americans with Disabilities Act
ADAAG	ADA Accessibility Guidelines for Buildings and Facilities
AGL	Above Ground Level
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BMP	Best Management Practices
Board Policies	Public Resources Code and Board of Forestry and Fire Protection
Board	California Board of Forestry and Fire Projection
BVI	Blade-Vortex Interaction
CAC	County Agricultural Commissioner
CalEPPC	California Exotic Pest Plant Council
Caltrans	California Department of Transportation
CARB	California Air Resources Board
CCR	California Code of Regulations
CDF	California Department of Forestry and Fire Protection
CDFA	California Department of Food and Agriculture
CDFG	California Department of Fish and Game
CDMG	California Department of Mines and Geology
CDPR	California Department of Pesticide Regulations
CDWR	California Department of Water Resources
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFI	Continuous Forest Inventory
cfs	cubic feet per second
CGS	California Geological Survey
CNDDB	California Natural Diversity Database
CNEL	Community Noise Equivalent Level
CNPS	California Native Plant Society
CO	Carbon Monoxide
CWHR	California Wildlife Habitat Relationship
dB	Decibels
dBA	A-weighted Decibels
DBH	Diameter at Breast Height
DFMP	Draft JDSF Management Plan
DO	Dissolved Oxygen
ECC	Emergency Command Center
EDD	California Employment Development Department
EEZ	Equipment Exclusion Zone
EIR	Environmental Impact Report
EO	Executive Order
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FAC	Food and Agricultural Code
FEMAT	Federal Ecosystem Management Assessment Team
FESA	Federal Endangered Species Act

FFB	Flatheaded Fir Borer
FL	Forest Lands
FPA	Forest Practice Act
FPRs	Forest Practice Rules
FSEIS	Final Supplemental Environmental Impact Statement
FWCA	Fish and Wildlife Coordination Act
GIS	Geographic Information System
HCP	Habitat Conservation Plan
HIS	High-Speed Impulsive
IFI	Intensive Forest Inventory
IPM	Integrated Pest Management
IWM	Integrated Weed Management
JDSF	Jackson Demonstration State Forest
LCF	Local Coastal Program
Ldn	day-night average noise level
Leq	Energy-Equivalent Noise Level
LSFC	Late Seral Forest Characteristics
LSFS	Late Succession Forest Stands
LTO	Licensed Timber Operator
LTSY	Long-Term Sustained Yield
LWD	Large Woody Debris
MAMU	Marbled Murrelet
MBF	Thousand Board Feet
MCAC	Mendocino County Agricultural Commissioner
MCAQMD	Mendocino County Air Quality Management District
MMBF	Million Board Feet
MOU	Memorandum of Understanding
MSP	Maximum Sustained Production
MTA	Mendocino Transit Authority
MWATs	Maximum Weekly Average Temperatures
MWSTA	Mendocino Woodlands Special Treatment Area
NCAQMD	North Coast Air Quality Management District
NF	North Fork
NMFS	National Marine Fisheries Service
NO_2	Nitrogen Dioxide
NOGO	Northern Goshawk
NOI	Notice of Intent
NOx	Nitrogen Oxides (ozone precursor)
NRHP	National Register of Historic Places
NSO	Northern Spotted Owl
O_3	Ozone
OHV	Off Highway Vehicle
PALCO	the Pacific Lumber Company
PM	Particulate Matter
PM10	Particulate Matter, less than 10 microns
PRC	Public Resources Code
PS	Public Service
PW	Planning Watersheds
QMD	Quadratic Mean Diameter
RL	Range Lands

RMR	Remote Residential
ROG	Reactive Organic Gases (ozone precursor)
RPF	Registered Professional Forester
RR	Rural Residential
RTV	Red Tree Vole
RWQCB	California Regional Water Quality Control Board, North Coast Region
SAM	Social Accounting Matrix
SCAs	Special Concern Areas
SF	South Fork
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SO_2	Sulfur Dioxide;
SOD	Sudden Oak Death
SPCC	Spill Pollution Control and Countermeasure Plan
STA	Special Treatment Area
State Parks	California Department of Parks and Recreation
SW	Solid Waste Landfill
SYP	Sustained Yield Plan
TDML	Total Daily Maximum Load
THP	Timber Harvesting Plan
TPZ	Timber Production Zone
UC	University of California
USDA	United States Department of Agriculture
USDA-APHIS	USDA-Animal and Plant Health Inspection Service
WDRs	Waste Discharge Requirements
WLPZ	Watercourse and Lake Protection Zone
WWAA	Watershed and Wildlife Assessment Area

APPENDIX 2
GLOSSARY

Age class — A management classification using the age of a stand of trees.

Alluvial — Referring to deposits resulting from natural river activity, including sediments laid down in river beds, flood plains, lakes, fans at the foot of mountain slopes, and estuaries.

Anadromous — A life history strategy in which fish are born and rear in freshwater, move to the ocean to grow and mature, and return to freshwater to reproduce; an example is chinook salmon (*Oncorhynchus tschawytscha*).

Bank stability — The ability of a stream bank to resist erosion.

Basal area — The cross-sectional area (in square feet) of tree coverage per acre, measured at breast height or 4.5 feet above the ground.

Beneficial use — In water use law, reasonable use of water for a purpose consistent with the laws and best interest of the people of the state. Such uses may include agricultural water supply; coldwater fish habitat; commercial and sport fishing; industrial water supply; migration of aquatic organisms; municipal and domestic water supply; navigation; recreation; and fish spawning, reproduction, and development.

Broadcast burning — The use of fire throughout a defined area to prepare it for regeneration. It does not include burning of organic matter that is piled during mechanical site preparation or for hazard reduction.

Bucking — Use of a saw to remove log lengths from a tree after it has been felled.

Buffer strip — A forested area located adjacent to a sensitive resource that reduces the effects of adjacent management actions on the resource.

Cable logging — The system of transporting logs by means of a cable (wire rope) to the yarding machine or a landing while the yarder remains stationary.

Candidate species — The USFWS classifies those species for which the agency has sufficient information to warrant a proposed listing as candidate species. For NMFS, candidate species are "any such species being considered [by NMFS] for listing as endangered or threatened species, but not yet the subject of a proposed rule."

Canopy closure — The degree to which the crowns of trees are nearing general contact with one another. Generally measured as the percentage of the ground surface that would be covered by a vertical projection of foliage in the crowns of trees.

Canopy cover	A measure of the percentage of potential open space occupied by the collective tree crowns in a stand.
Category 2 candidate species	A former classification of the USFWS and NMFS for species for which a proposed listing was possible, but for which the Services did not possess the necessary information to warrant a proposed listing decision.
Changed circumstances	As defined in the No Surprises rule and the Implementation Agreement, changed circumstances means changes in circumstances affecting a species or area covered by the HCP that is or can be reasonably anticipated and planned for in the HCP and Implementation Agreement.
Channel type	A classification of stream channels based on stream gradient and degree of confinement.
Class I watercourse	Defined by the California Forest Practices Rules as watercourses in which fish are always or seasonally present onsite or within 100 feet downstream of an operations area. This designation includes domestic water supplies such as springs and habitat to sustain fish migration and spawning.
Class II watercourse	Defined by the California Forest Practices Rules as watercourses in which fish are always or seasonally present offsite within 1,000 feet downstream or provide aquatic habitat for nonfish aquatic species. This designation excludes Class III waters that are tributary to Class I waters.
Class III watercourse	Defined by the California Forest Practices Rules as watercourses in which no aquatic life is present. The watercourse shows evidence of being capable of sediment transport to Class I and II waters under normal high flow conditions after completion of timber operations.
Clearcut/ Clearcutting	A harvest method where an entire stand of trees is removed in one cutting operation, leading to the establishment of an even-aged stand.
Coarse sediment	Fine gravel and larger-sized particles deposited by water or ice.
Codominant trees	Trees with crowns forming the general level of the forest canopy and receiving full light from above, but comparatively little light from the sides. Codominants usually have medium-sized crowns, but are crowded on the sides. See also "Dominant trees."
Commercial harvest	Removal of merchantable trees from a stand.
Cull	A tree or log that does not meet merchantable specifications.

Cumulative effect	The change in the environment that results from the incremental impact of the action when added to other closely related past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time.
Diameter at breast height	The diameter of a tree 4.5 feet above the ground on the uphill side of the tree.
Dissolved oxygen	Oxygen found in solution with water in streams and lakes. Solubility is generally measured in mg/l and varies with temperature, salinity and atmospheric pressure.
Dominant trees	Trees with well-developed crowns extending above the general level of the forest canopy and receiving full light from above and partly from the sides. See also "Codominant trees."
Drainage	An area (basin) mostly bounded by ridges or other similar topographic features, encompassing part, most, or all of a watershed.
Early-seral	The biotic community that develops immediately following the removal or destruction of the vegetation in an area; an example is wildlife destruction. The stage in forest development that includes seedling, sapling, and pole-sized trees.
Early-successional	See "Early-seral."
Edge	The place where different plant communities meet or where different successional stages or vegetative conditions within plant communities come together.
Element	A biotic or abiotic feature that is a component of a habitat patch, but which occurs somewhat independently of overall patch conditions.
Embeddedness	The extent to which streambed cobbles are surrounded or buried by fine sediments, usually assessed by visual examination of spawning riffles and pool tailouts.
Endangered	A plant or animal which is in danger of extinction throughout all or a significant portion of its range.
Equipment exclusion zone	An area where heavy equipment associated with timber operations is totally excluded for the protection of water quality, the beneficial uses of water, or other forest resources.
Equipment Limitation Zone	An area where use of equipment associated with timber operations is limited for the protection of water quality, the beneficial uses of water, or other forest resources.

Even-aged	A forest stand composed of trees with less than a 20-year difference in age.
Even-aged management	The application of a combination of actions that results in the creation of stands in which trees of essentially the same age grow together. Clearcut, shelterwood, or seed tree cutting methods produce even-aged stands.
Fish-bearing watercourse	A watercourse in which fish are always or seasonally present.
Forest fragmentation	Isolating or breaking up large tracts of forest as a result of natural events (such as wildfire) or by the implementation of timber management or other human activities.
Forest management	Activities undertaken for the purpose of harvesting, traversing, transporting, protecting, changing, replenishing, or otherwise using forest resources.
Habitat	The sum of environmental conditions at the landscape, patch, and element scales necessary to meet the life requirements of individuals of a species.
Heel-boom loader	A stationary piece of log loading equipment used on roads and landings, similar to a construction crane, with a crane-like grapple to deck, move, and load logs onto log trucks from one central pivot point.
Implementation Agreement	An agreement that legally binds the permittee to the requirements and responsibilities of a conservation plan and Section 10 permit or Section 2081(b) permit.
Incidental take	Take of any federally listed or state-listed wildlife species that is incidental to, but not the purpose of, otherwise lawful activities. See also "Take."
Insloping	Describes a road where the outer edges of the road tread surface are higher than the inner edge, thus directing runoff across a road into a ditch adjacent to the sideslope. See also "Outsloping."
Interior forest	The portion of the mature and old-growth forest that is buffered and protected from edge effects.
Issuance criteria	The conditions specified under Section 10 of the Endangered Species Act that an applicant must fulfill to receive an incidental take permit.
JDSF Management Plan	The latest draft of the JDSF Management Plan.

Landscape	An area composed of interacting ecosystems that are variously repeated in response to geology, land form, soils, climate, biota, and human influences throughout the area.
Large woody debris	Logs, root wads and large branches that intrude into a stream channel.
Late-seral	The stage in forest development that includes mature and old-growth forest.
Late-successional	See "Late-seral."
Life history requirements	Physical and biological requirements of a species necessary to carry out essential behaviors from birth to death.
Listed species	Species, including subspecies and distinct vertebrate populations, of fish, wildlife, or plants listed as either endangered or threatened under Section 4 of the federal Endangered Species Act or under the California Endangered Species Act.
Management Plan	The latest draft of the JDSF Management Plan.
Mass soil movement	All geologic processes in which large masses of earth materials move downslope by gravitational forces.
Mature forest	A defined stand of trees for which the annual net rate of growth has culminated. Stand age, diameter of dominant trees, and stand structure at maturity vary by forest cover types and local site conditions. Mature stands generally contain trees with a smaller average diameter, less age-class variation, and less structural complexity than old-growth stands of the same forest type.
Maximum sustained timber production	A level of harvest mandated by the California Forest Practice Rules that balances growth and harvest over time.
Maximum weekly average temperature	The maximum value of the mean of multiple, equally spaced, daily temperatures over consecutive 7-day periods.
Mesic	Pertaining to or adapted to an area that has a balanced supply of water — neither wet or dry.
Microclimate	The climatic conditions that influence organisms in a small or restricted area.
Mid-seral	The period in the life of a forest stand from crown closure to first merchantability. Brush, grass, or herbs rapidly decrease in the stand because of stand density.

Multi-layered	Term applied to forest stands that contain trees of various heights and diameter classes and, therefore, support foliage at various heights in the vertical profile of the stand.
Multi-storied	See "Multi-layered."
No Surprises rule	The Services' rule wherein no additional land, funds, or restrictions on lands will be required of an HCP permittee where the permittee is adequately implementing an approved HCP.
Old-growth	A forest stand with moderate to high canopy closure; a multi-layered, multi-species canopy dominated by large overstory trees; a high incidence of large trees with large, broken tops, and other indications of decadence; numerous large snags; and heavy accumulations of logs and other woody debris on the ground.
Outsloping	Describes a road where the inner edges of the road surface are higher than the outer edges of the road. Consequently, runoff is directed onto the sideslope downhill of the road. See also "Insloping."
Overstory	The portion of trees in a forest that forms the uppermost layer of foliage.
Partial-cutting	Removal of selected trees from a forest stand.
Patch	The physical space where individuals of a given species are expected to be found, often referred to as the habitat type or habitat condition.
Plan	The latest draft of the JDSF Management Plan.
Pool	Channel feature characterized by a wide, uniform channel bottom, low velocity, and lacking turbulence or entrained air. Substrates often consist of gravel and sand.
Precommercial thinning	The practice of removing some of the trees of less-than-merchantable size from a stand so that remaining trees will grow faster.
Rare	A State of California classification for a plant species that is not at present threatened with extinction, but the species, subspecies, or variety is found in such small numbers throughout its range that it may be endangered if its environment worsens.
Recovery	The point at which the measures provided pursuant to the federal Endangered Species Act are no longer necessary to conserve a listed species.
Regeneration	The renewal of a tree crop by natural or artificial means. Also the young tree crop (seedlings and saplings) itself.

Regeneration harvest	Used in reference to clearcut, seed tree, and shelterwood cut harvest methods that remove an existing stand to prepare a site for regeneration.
Residual	A tree that remains standing after some event such as selection harvest.
Riffle	A channel feature characterized by swiftly flowing, turbulent water and exposed substrate, usually cobble and boulder dominated.
Riparian	That portion of the watershed or shoreline influenced by surface or subsurface waters, including stream or lake margins, marshes, drainage courses, springs, and seeps.
Riparian management zone	An area allocated in a plan primarily to protect the riparian or streamside zone.
Rookery	A nesting or roosting colony of gregarious birds.
Rotation	The planned number of years required to establish (including the regeneration period) and grow timber crops to a specified condition or maturity for regeneration harvest.
Rotation age	The age of a stand when it is harvested at the end of a rotation.
Salmonid	A member of the fish family *Salmonidae*, which includes all species of salmon and trout.
Sanitation-salvage harvest	The removal of dead or damaged trees, or trees susceptible to insect and disease attack such as intermediate and suppressed trees, essentially to prevent the spread of pests or pathogens and to promote forest health.
Second-growth	Timber stands established after natural or human-caused removal of the original stand or previous forest growth.
Sedimentation	The deposition of material along a stream channel.
Selection harvest	The annual or periodic removal or trees, individually or in small groups, from an uneven-aged forest to realize yield and establish a new stand.
Sensitive species	A species designated by the California Board of Forestry pursuant to 14 CCR 898.2(d). These species currently are bald eagle, golden eagle, great blue heron, great egret, northern goshawk, osprey, peregrine falcon, California condor, great gray owl, northern spotted owl, and marbled murrelet.
Single-tree selection harvest	The selection of trees for harvest based on individual tree characteristics.

Snag	A standing dead tree.
Species of Concern	An informal means of referring to species formerly classified as Categories 2 or 3; such species are no longer afforded any particular status by the USFWS under the Endangered Species Act listing process.
Stand inventory	An inventory of a forest stand's characteristics such as age, tree size, species composition, and volume.
Status	The classification of a species regarding its position in the listing process under the state or federal Endangered Species Acts.
Stocking level	The degree to which trees occupy the land, measured by basal area or number of trees by size and spacing, compared with a stocking standard; that is, the basal area and/or number of trees required to fully utilize the land's growth potential.
Suspended sediment	Sediment suspended in a fluid by the upward components of turbulent currents or by colloidal suspension.
Sustained yield	The yield of commercial wood that an area can produce continuously at a given intensity of management. These yields are professionally planned to achieve a balance between growth and removal over time.
Take	Defined under Section 3(19) of the federal Endangered Species Act as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct," with respect to federally listed endangered species of wildlife. Federal regulations further define these terms and provide the same taking prohibitions for threatened wildlife species. Defined under Section 86 of the California Fish and Game Code, take for solely state-listed species means "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, capture, or kill." See also "Incidental take."
Talus	A slope landform, typically covered by coarse rock debris forming a more or less continuous layer that may or may not be covered by duff and litter.
Thinning	The removal of trees in a stand to increase the growth of the remaining trees.
Threatened	A plant or animal species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
Tractor logging	Use of a tractor to carry logs from the harvest site to a landing.
Tree size class	A management classification using the sizes of trees in a stand.

Understory	Vegetation (tree or shrubs) growing under the canopy formed by larger trees.
Uneven-aged	A forest stand composed of trees in a range of age classes.
Uneven-aged management	The application of a combination of actions needed simultaneously to maintain continuous forest cover, recurring regeneration of desirable species, and the orderly growth and development of trees through the range of diameter or age classes. Cutting methods that develop and maintain uneven-aged stands are single-tree selection and group selection.
Unforeseen circumstances	As defined in the No Surprises rule and Implementation Agreement, unforeseen circumstances means changes in the circumstances affecting a species or area covered by an HCP that were not or could not reasonably be anticipated by the HCP participants and the Services, and that result in a substantial and adverse change in the status of a covered species.
Unlisted species	Fish, wildlife, or plant species not currently listed as threatened or endangered under the federal or state Endangered Species Acts.
Unlisted species coverage	Coverage under an HCP and incidental take permit for species that are currently unlisted, but which become listed during the term of the incidental take permit.
Unmerchantable	Faulty logs that are not salable.
Watercourse	Any well-defined channel with a distinguishable bed and bank showing evidence of having contained flowing water indicated by deposits of rock, sand, gravel, or soil.
Watercourse and lake protection zone	A strip of land, along both sides of a watercourse or around the circumference of a lake or spring, where additional management practices may be required for erosion control and for protection of the quality and beneficial uses of water, fish, and riparian wildlife habitat.
Watershed	The entire land area that drains to a specific location.
Wheeled front-end loader	A machine with special forks, lifts, or grapples for loading logs onto trucks, pallets, or railcars.
Yarding	A method of bringing logs to a roadside area or landing for truck transport.

APPENDIX 3
LIST OF PREPARERS & CONTRIBUTORS

The following individuals contributed to the preparation of this EIR.

Name	Responsibility
California Department of Forestry and Fire Protection	
Marc Jameson	JDSF Forest Manager
John Griffen	JDSF Forester
William Baxter	JDSF Forester
Craig Pederson	JDSF Forester
Allen Robertson	Environmental Coordinator
Dr. Helge Eng	Inventory, Growth and Yield Specialist
Daniel Foster	Supervisor, Archaeology Program
Christopher Rowney	Manager, State Forest Program
Natural Resources Management Corporation	
Gary Rynearson	President
James H. Hawkins	Forester
Dr. Gerald M. Allen	Inventory, Growth and Yield Assessment
Dr. Dale A. Thornburgh	Forest Structure Development
James L. Lindquest	Silviculture Assessment
Dr. Peter Berke	Economic Analysis
Robert J. Kelley	Forester
Dennis Halligan	Fisheries Biologist
Dirk Embree	Wildlife Biologist
David Loya	Botanist
Kim Hayler	Botanist
Dr. Colette Beaupre	Plant Pathologist
Sandra Brown	Hydrologist
David Glen	GIS Specialist
Sherman Garinger	GIS Technologist
SHN Consulting Engineers & Geologists, Inc.	
Larry Henderson	EIR Project Manager; NEPA/CEQA Compliance
Dan Little	Environmental Assessment Coordinator
Laurie Schwabe	Technical Writer and Document Management
Gary Simpson	Certified Engineering Geologist
Aimee Weber	Environmental Specialist
Seth Lancaster	Environmental Specialist, Asst Project Manager
SHN Subconsultants	
Patrick Miller (**2M**)	Recreation and Aesthetics Consultant
Bill Popenuck	Air Quality Consultant
Janet Eidsness	Heritage Resources Management Consultant
Ann King Smith	Cultural Resources Consultant

Note: while the above individuals have contributed to the preparation of the DEIR, the evaluations and conclusions presented are solely the responsibility of the Department of Forestry and Fire Protection, SHN Consulting Engineers & Geologists, and Natural Resources Management.

APPENDIX 4
NOTICE OF PREPARATION OF A DRAFT ENVIRONMENTAL IMPACT REPORT FOR THE JACKSON DEMONSTRATION STATE FOREST MANAGEMENT PLAN

1. SUMMARY INFORMATION

Project Name: Jackson Demonstration State Forest Management Plan

Project Location: near Fort Bragg, Mendocino County, California

Lead Agency: California Department of Forestry and Fire Protection

Lead Agency Contact: Mr. Marc Jameson, Forest Manager
California Department of Forestry and Fire Protection
Coast Cascade Region Office
135 Ridgeway Avenue
Santa Rosa, CA 95401

Send Comments to: Mr. Allen Robertson, Environmental Coordinator
California Department of Forestry and Fire Protection
Room 1516-24
P.O. Box 944246
Sacramento, CA 94244-2460

Comment Period Ends: May 1, 2000 @ 4:00 P.M.

2. INTRODUCTION

The California Department of Forestry and Fire Protection (CDF) is beginning the process of preparing a Forest Management Plan for the Jackson Demonstration State Forest (JDSF). The Management Plan will establish management goals and a management direction for the Forest. Some of the more important aspects of the Management Plan will be to balance and prioritize management activities for the coming decade. In addition, the Management Plan will establish general levels of management for forest management demonstration, recreational activities, annual timber harvest, and fish and wildlife habitats. The requirement for, and content of, the Management Plan are set forth in California law and by the State Board of Forestry and Fire Protection Policies.

In addition to the Management Plan, CDF will prepare an Environmental Impact Report (EIR) in compliance with the California Environmental Quality Act (CEQA). The EIR will describe and analyze the environmental impacts of the Management Plan and compare and contrast those impacts with a series of alternatives to the Plan.

The draft Management Plan is expected to be available for public review by mid-2000, with the final Plan completed in late-2000. The EIR is expected to be available for public review by late-2000, with the final EIR completed in 2001.

With this Notice of Preparation CDF is soliciting public and agency comment on the scope of the analysis and issues to be considered, the potential environmental impacts of the Plan and alternatives to the Plan. Please submit your comments, either orally or in writing, as described below.

3. PROJECT LOCATION

Jackson Demonstration State Forest is located in Mendocino County, California, between the cities of Willits and Fort Bragg.

4. PROJECT DESCRIPTION

Jackson Demonstration State Forest (JDSF) is a 50,195-acre forest that consists primarily of redwood, Douglas-fir, and hardwood tree species and that is managed by the California Department of Forestry and Fire Protection (CDF). JDSF is managed for a variety of benefits, including "Demonstration" projects in forest management, watershed, fisheries, and wildlife. CDF cooperates in forest research and demonstration projects with other resource agencies, the University of California, Humboldt State University, California Polytechnic State University, the U.S. Forest Service Redwood Sciences Laboratory, and others.

JDSF has an estimated timber inventory of more than 2 billion board feet, with an annual growth level estimated at 40 to 50 million board feet. JDSF currently produces an annual timber harvest of approximately 29 million board feet of redwood, Douglas-fir, and whitewood logs. This timber is sold annually to bidders, harvested by local logging contractors, and is shipped to a number of sawmills throughout the redwood region and California. Substantial numbers of jobs are produced by this timber management activity, as well as tax revenues.

This publicly owned forest is also utilized as an important recreational resource by local citizens, travelers, and vacationers from throughout the County, State, and country. There are over 60 individual campsites, many miles of riding and hiking trails, and over 200 miles of forest road utilized by the public. Other common recreational activities conducted on the Forest include picnicking, hunting, swimming, wildlife viewing, and target shooting. The Forest is also an important local source of firewood and other minor forest products such as mushrooms and greenery for both personal and commercial use.

The Forest is home to a number of sensitive fish and wildlife species, including the northern spotted owl, coho salmon, and steelhead. The Forest provides habitat for a large number of species, and habitat protection is an important element of forest management activities.

5. POTENTIALLY SIGNIFICANT EFFECTS OF THE PROJECT

Forest management and timber harvesting activities, recreational activities, forest management demonstrations, and collection of minor forest products, unless mitigated, may cause potentially significant environmental effects, such as noise, traffic, aesthetic degradation, changes in wildlife habitat, soil disturbance, reduction in water quality, and interruption of recreational opportunities. Measures to avoid, minimize, or otherwise mitigate potential significant impacts will be incorporated into the Management Plan. CDF expects that the potential impacts will be mitigated to a level considered less than significant. Because JDSF will continue to be managed as a demonstration forest, including the multiple uses listed above, the project is expected to have positive environmental and economic benefits overall.

6. ALTERNATIVES TO THE PROPOSED PROJECT

Environmental Impact Reports are required to evaluate a variety of alternatives to the proposed project that both meet the objectives of the project proponent and serve to mitigate the proposed project's potentially significant environmental impacts. The final array of management activities proposed in the Management Plan is likely to borrow desired elements from several of these alternatives, as well as from other suggestions received during public and agency review. CDF intends to analyze several alternatives to the proposed project as described, below.

Alternative 1. The **Current Forest Management Alternative** describes JDSF maintaining the current level of forest management demonstration, timber production, recreational development, and environmental protection. It includes an annual timber harvest of about 29 million board feet and conservative harvesting practices that meet or exceed the requirements of the California Forest Practice Rules (CFPR). This alternative includes protection of listed species, and recruitment of recovery habitat for listed species as opportunities arise. A demonstration program is included that explores basic forest processes. It also includes the maintenance of existing recreational facilities. This alternative accommodates changes in laws and regulations that affect management activities, most specifically changes in the CFPRs and the Endangered Species Act. This alternative describes a low to moderate level of timber production, a moderate level of wildlife, with a low level of recreation facility development.

Alternative 2. The **Maximization of Long-Term Sustained Yield With Enhanced Demonstration Alternative** describes JDSF increasing the annual timber production level over time to a level consistent with the productive capacity of the Forest and consistent with other constraints. This alternative describes a timber management program based on determining and working towards a long-term desired future condition. This alternative could increase timber production and annual revenues by as much as 50 percent over several decades. This alternative includes a high level of timber productivity and moderate wildlife protection, with a similar level or type of recreational use as the Current Forest Management Alternative.

Alternative 3. The **Forest Management Demonstration Alternative** describes JDSF management with a demonstration mandate for all forest management activities. Timber harvesting would occur only as a by-product of demonstration and research projects. This alternative includes a very low to moderate, but fluctuating level of timber production, a moderate to high level of wildlife protection, and a high level of recreational development.

Alternative 4. The **Wildlife Protection Alternative** has a conservation-oriented approach to management of wildlife and aquatic resources. The desired future condition is developed in terms of a habitat mosaic suitable for protection and recruitment of both listed species and other species of concern. This alternative defines a low level of timber production limited to management activities designed to create or enhance fish and wildlife habitats. Demonstration projects would be directed at habitat use, creation, and enhancement.

Alternative 5. The **Specific Constraint Alternative** incorporates the provisions of Alternative 4, as well as many of the recommendations submitted by local interest groups. This alternative defines a specific set of constraints, such as the preservation of a substantial portion of JDSF to develop naturally towards a late-seral forest condition. This alternative would restrict the use of herbicides for control of exotic species and native species in competition with conifers. This alternative limits the management of timber to uneven-aged systems like individual tree selection. This alternative defines a high level of recreational use. There is an emphasis placed on economic benefits directed towards the local community, such as low-volume timber sales to small businesses.

Each of the alternatives outlined above incorporates varying levels of commodity management, forest management demonstration, wildlife habitat protection and management, and recreational use. The public should be aware that these distinct aspects of forest management and use are not necessarily mutually exclusive. The degree of management demonstration activities conducted is controlled primarily by allocation of personnel and financial resources, not the level of timber management or recreational use on the Forest. However, the level of timber production will affect the kinds of management demonstration activities that can be performed.

7. TECHNICAL SESSION

CDF will hold a Technical Session to present information collected from recent planning, research and monitoring activities at JDSF. The interested public is invited to attend. The Technical Session is scheduled for Thursday, March 30, 2000, from 2 – 5 P.M. and 6 – 9 P.M. at the Ukiah Conference Center. Please see the attached flier for more information.

8. PUBLIC SCOPING

Public comments on the Management Plan and accompanying Environmental Impact Report are welcome. Scoping meetings will be held on:

April 11, 2000, from 3 to 6 P.M. and from 7 to 9 P.M.
Redwood Empire Fairgrounds
1055 N. State Street, Ukiah

April 12, 2000, from 3 to 6 P.M. and from 7 to 9 P.M.
Tradewinds Lodge
400 S. Main Street, Fort Bragg

April 13, 2000 from 3 to 6 P.M. and from 7 to 9 P.M.
Vagabond Executive
2030 Arden Way, Sacramento

You may address written comments to:

Mr. Allen Robertson
Environmental Coordinator
California Department of Forestry and Fire Protection
P.O. Box 944246
Sacramento, CA 94244-2460

Written comments will be accepted until May 1, 2000 @ 4:00 P.M.

APPENDIX 5
BOARD POLICIES GOVERNING STATE FORESTS

This appendix pulls together in one place for convenient reference the legislation, regulations and Board of Forestry and Fire Protection policies that pertain to State Forests.

1. PUBLIC RESOURCES CODE

708. For the purpose of disseminating information relating to its activities, powers, duties, or functions, the department, with the approval of the Department of General Services, may issue publications, construct and maintain exhibits, and perform such acts and carry on such functions as in the opinion of the director will best tend to disseminate such information. Such publications may be distributed free of charge to public libraries and to other state departments and state officers. The department may exchange copies with contemporary publications. All money received by the department from the sale of publications shall be paid into the State Treasury to the credit of the General Fund.

740. The board shall represent the state's interest in the acquisition and management of state forests as provided by law and in federal land matters pertaining to forestry, and the protection of the state's interests in forest resources on private lands, and shall determine, establish, and maintain an adequate forest policy. General policies for guidance of the department shall be determined by the board.

4332. Whenever it is necessary in the interests of public peace or safety, the director, with the consent of the Governor, may order closed to camping, hunting, trapping, or the use of firearms, any area in any state park or state forest. The director shall post and enforce such closure order in such area.

4333. Any order which is issued pursuant to Section 4332 shall be published twice in at least one newspaper of general circulation in any county that is affected by the order. The publication shall be separated by a period of not less than one week and not more than two weeks. The order shall also be posted in such public places in each county as the director may direct, and along roads and trails which pass through such areas declared to be closed to camping or entry.

4631. It is hereby declared to be in the interest of the welfare of the people of this state and their industries and other activities involving the use of wood, lumber, poles, piling, and other forest products, that desirable cutover forest lands, including those having young and old timber growth, be made fully productive and that the holding and reforestation of such lands is a necessary measure predicated on waning supplies of original old growth timber. It is further declared to be the policy of the state to acquire by purchase, exchange, lease, or grant all of the following:

a) Such cutover lands, the reforestation of which is not assured under private ownership, to reforest such lands during periods of unemployment and at other times.
b) Liquidating forest lands primarily suitable for timber production which may be acquired under precutting agreements.

c) Demonstration forests of 2,000 acres or less adapted to furnish local needs of investigation, demonstration, and education in those timber counties where the ownership pattern is such that management of small areas is an important problem.
d) One area, not to exceed approximately 40,000 acres, in each of the following forest districts, Coast Range Pine and Fir District, North Sierra Pine District and the South Sierra Pine District, for the purpose of demonstration of economical forest management. These areas shall not include virgin timber except that which is incidental to areas previously harvested.

4631.5. It is further declared to be in the interest of the welfare of the people of this state that the state do all of the following:
a) Retain the existing land base of state forests in timber production for research and demonstration purposes.
b) Cooperate with local governments in mitigating the impacts on school enrollment of geothermal development which occurs in proximity to state-owned forest lands.

4635. Unless the context otherwise requires, the definitions in this article govern the construction of this chapter.

4636. "Continuous production" means such management as will approach a balance between depletion and growth.

4637. "Forest land" means lands primarily suited to growing timber and other forest products.

4638. "Forest products" includes sawlogs, pilings, poles, split products, pulpwood, bolts, bark and other products.

4639. "Management" means the handling of forest crop and forest soil so as to achieve maximum sustained production of high quality forest products while giving consideration to values relating to recreation, watershed, wildlife, range and forage, fisheries, and aesthetic enjoyment.

4640. "Protection" means protection of forest trees against damage by fire, insects, disease, and trespass.

4641. "Purchase area" means an area of forest land within which forest lands of sufficient acreage may be available and can be consolidated to make state forest units.

4642. "Reforestation" includes reforestation by natural means from seed and artificially by seeding or planting.

4643. "State forest" means forest land owned or to be owned by the state.

4645. The department, in accordance with plans approved by the board, may engage in the management, protection, and reforestation of state forests.

4646. The director, acting in accordance with policies adopted by the board, shall administer this chapter. He may exercise all powers necessary to accomplish its purposes and intent.

4647. The department shall prepare a map setting forth the boundaries of purchase areas, and it shall prepare data relating to the forest conditions within these areas. In the preparation of the map and data the department shall be guided by, but not limited to, a report prepared and submitted to the Legislature by the California Forestry Study Committee provided for in Chapter 1086, Statutes of 1943. The department shall make the necessary surveys, examinations, appraisals, inventories, and title searches and obtain other pertinent data and information bearing on tracts of forest land offered for sale for state forest purposes.

4648. Acquisition of forest land pursuant to this chapter shall be made only upon the approval of the director. Approval by the director shall be based on satisfactory evidence presented to him by the board as to the suitability and desirability of lands under consideration for purchase for state forest purposes. This suitability and desirability shall be predicated on, but not limited to, the following factors:

a) That the lands are suited primarily to timber growing.
b) That the lands represent growing capacities not below the average for the timber region.
c) That they are favorably situated for multiple use and economical administration, management, and utilization.

The director shall not approve the acquisition of any lands pursuant to this chapter unless he receives a resolution recommending such action adopted by the board of supervisors of the county in which such lands are situated following a public hearing held by the board of supervisors on the proposed acquisition. Notice of the hearing shall be published pursuant to Section 6066 of the Government Code. The holding of a hearing shall be optional to the board of supervisors for areas of 2,000 acres or less. Upon approval of a purchase by the director, the department may negotiate for and consummate the purchase of the lands.

4649. Whenever it is deemed advisable and advantageous, the board may enter into an agreement with the Department of Corrections, or the Youth Authority for employment of inmates of these institutions in work on state forests.

4650.

a) With the approval of the Director of General Services, the director may make sales of forest products from state forests that do not exceed ten thousand dollars ($10,000) in value without advertising for bids. With the approval of the Director of General Services, the director may also make sales that do not exceed 100,000 board feet of dead, dying, downed, diseased, or defective trees, trees harvested in connection therewith for thinning purposes or other forest improvement work, or any combination thereof, without advertising for bids.
b) Any sale of forest products in excess of ten thousand dollars ($10,000) in value, or in excess of 100,000 board feet with respect to dead, dying, downed, diseased, or defective trees, trees harvested in connection therewith for thinning purposes or other forest improvement work, or any combination thereof, shall be upon competitive bids. Advertising for bids shall be the same as is generally in use for the sale of state property.

4650.1.

a) Notwithstanding any other provision of law, timber from state forests shall not be sold to any California division of a primary manufacturer, or to any person for resale to a primary manufacturer, who does either of the following:

1) Uses that timber at any plant not located within the United States unless it is sawn on four sides to dimensions not greater than 4 inches by 12 inches.
2) Within one year prior to the bid date and one year after the termination of the contract, sells unprocessed timber, which is harvested from private timberlands and is exported into foreign commerce from this state.

b) Any purchaser of timber from state forests who makes use of timber in violation of paragraph
1) of subdivision (a) is prohibited from purchasing state forest timber for a period of five years and may have his or her license suspended for a period of up to one year.

c) (c) The department may adopt appropriate regulations to prevent the substitution of timber from state forests for timber exported from private timberlands.

d) (d) For purposes of this section, "unprocessed timber" means trees or portions of trees or other roundwood not processed to standards and specifications suitable for end product use, but does not include timber processed into any of the following:
1) Lumber or construction timbers, except Western Red Cedar, meeting current American Lumber Standards Grades or Pacific Lumber Inspection Bureau Export R or N list grades, sawn on four sides, not intended for remanufacture.
2) Lumber, construction timbers, or cants for remanufacture, except Western Red Cedar, meeting current American Lumber Standards Grades or Pacific Lumber Inspection Bureau Export R or N list clear
3) grades, sawn on four sides, not to exceed 12 inches in thickness.
4) Lumber, construction timbers, or cants for remanufacture, except Western Red Cedar, that do not meet the grades referred to in paragraph (2) and are sawn on four sides, with wane less than 1/4 of any face, not exceeding 83/4 inches in thickness.
5) Chips, pulp, or pulp products.
6) Veneer or plywood.
7) Poles, posts, or piling cut or treated with preservatives for use as such.
8) Shakes or shingles.
9) Aspen or other pulpwood bolts, not exceeding 100 inches in length, exported for processing into pulp.
10) Pulp logs or cull logs processed at domestic pulp mills, domestic chip plants, or other domestic operations for the purpose of conversion of the logs into chips.

4651. The management of state forests and the cutting and sale of timber and other forest products from state forests shall conform to regulations prepared by the director and approved by the board. These regulations shall be in conformity with forest management practices designed to achieve maximum sustained production of high-quality forest products while giving consideration to values relating to recreation, watershed, wildlife, range and forage, fisheries, and aesthetic enjoyment. The sale of timber and other forest products is limited to raw materials only.

4652. Receipts from the sales of forest products shall be deposited monthly with the State Treasurer in the Forest Resources Improvement Fund. The Controller shall keep a record of accounts of such receipts separately.

4653. State-owned lands classified by the department and approved by the board as not suited to the growing of forest products, or necessary to the management of the forest, shall be sold according to state laws.

4654. There shall be paid to each county in which lands acquired for state forest purposes are situated, out of funds hereafter made available for such purpose, an amount equivalent to taxes levied by the county on similar land similarly situated in the county in the same manner as provided in the Revenue and Taxation Code for secured property tax payments as long as the state continues to own the land.

Such payments shall be based only upon the value of the forest lands used for purposes of continuous commercial forest production and not upon value of such forest land used for any other purposes, including any improvements on such lands. Determination of what constitutes similar land similarly situated shall be made by a committee consisting of the county assessor of the county in which the land is located, a representative of the State Board of Equalization and a representative of the department.

The money received by any county pursuant to this section may be expended by it for any proper state purpose not prohibited by the State Constitution.

4655. Tax-deeded lands classified as forest lands, pursuant to Chapter 4.3 (commencing with Section 3534), Part 6, Division 1 of the Revenue and Taxation Code, may be acquired for the state forest purposes through the usual procedure governing the sale of tax-deeded lands.

4656. This chapter does not interfere with the reasonable use of state forests for hunting, fishing, recreation and camping, except as otherwise provided by law.

The use of state forest lands for grazing and mining purposes shall be permitted pursuant to regulations established by the board in accordance with Chapter 3. 5 (commencing with Section 11340) of Part 1 of Division 3 of Title 2 of the Government Code. The use and development of water facilities for irrigation and power shall be permitted as provided by law.

4656.1. The board may establish rules and regulations, in accordance with Chapter 3.5 (commencing with Section 11340) of Part 1 of Division 3 of Title 2 of the Government Code, for the preservation, protection, and use of state forests and for the promotion and protection of public health and safety within state forests.

4656.2. The department shall protect the state forests from damage and preserve the peace therein.

4656.3. Any person who violates the rules and regulations pertaining to the state forests established by the board is guilty of a misdemeanor and upon conviction shall be punished by a fine not exceeding one thousand dollars ($1,000).

4657. Insofar as the provisions of this chapter may be in conflict with any other provision of this division, the provision of this chapter shall control.

4658. The Mountain Home Tract Forest in Tulare County shall be developed and maintained, pursuant to this chapter, as a multiple-use forest, primarily for public hunting, fishing, and recreation. In future acquisitions and exchanges of land, as provided by law, the acreage in state ownership shall not be reduced below 4,000 acres.

4660. It is hereby declared to be the policy of the state to establish and preserve an intensively managed, multifaceted research forest which is representative of forest activities as a living forest in Santa Cruz County within northern California's coastal redwood belt. The coast redwoods, as the dominant tree species in this area, are a valuable natural resource and are unique in North America for their beauty, abundance, diversity, and public accessibility, and their extreme beauty and economic value requires special measures for their protection for the use, enjoyment, and education of the public.

It is the intent of the Legislature, in establishing the Soquel Demonstration State Forest, to provide an environment that will do all of the following:

a) Provide watershed protection for local communities and base-line monitoring and studies of the hazards, risks, and benefits of forest operations and watersheds to urban areas.
b) Provide public education and examples illustrating compatible rural land uses, including sustained yield timber production, as well as the historic development of timbering and forestry machinery, within the context of local community protection and nearby pressures.
c) Provide a resource for the public, environmental groups, elected officials, environmental planners, the educational community, and the media as an open environment for the inspection and study of environmental education, forestry practices, and effects thereof.
d) Protect old growth redwood trees.

4661. The department may permit a limited amount of commercial timber operations on the property within the Soquel Demonstration State Forest in order to provide funds for the maintenance and operation of the state forest and to allow fulfillment of the objectives of Section 4660. Income from the state forest property shall sustain all costs of operation and provide income for research and educational purposes.

4662. The department is responsible for the establishment and development of the Soquel Demonstration State Forest and for ongoing maintenance and operations. The director shall appoint an advisory committee to assist the department in planning future management of the forest. The advisory committee shall include representatives of the Santa Cruz County Board of Supervisors, the Department of Parks and Recreation, the State Board of Forestry and Fire Protection, the Forest of Nisene Marks Advisory Committee, and the Department of Fish and Game.

4663. The department, in coordination with the advisory committee, shall adopt by January 1, 1989, a general plan for the state forest which reflects the long-range development and management plans to provide for the optimum use and enjoyment of the living forest, as provided in Section 4660, as well as the protection of its quality and the watershed within the Santa Cruz area. The general plan shall be approved by the advisory committee prior to adoption by the department.

4664. The duties and authority of the department pursuant to this article shall only arise if the state acquires the property comprising the Soquel Demonstration State Forest.

4799.13.

a) There is hereby created in the State Treasury, the Forest Resources Improvement Fund. The money in the Forest Resources Improvement Fund may only be expended, upon appropriation by the Legislature, for the following purposes:
    1) Forest improvement programs and related administrative costs pursuant to Chapter 1 (commencing with Section 4790).

2) Urban forestry programs and related administrative costs pursuant to Chapter 2 (commencing with Section 4799.06).
3) Wood energy programs pursuant to Chapter 4 (commencing with Section 4799.14).
4) Reimbursing the General Fund for the cost of operation of the state forests administered by the director pursuant to Section 4646.
5) Cost of operations associated with management of lands held in trust by the state and operated as demonstration state forests by the department pursuant to Section 4646, if those lands are managed so that they produce revenue that offsets, within a reasonable period of time, any costs to the state of managing those lands
6) Forest pest research and management, technical transfer, and outreach.
7) State nurseries programs pursuant to Article 2 (commencing with Section 4681) of Chapter 10 of Part 2.
8) Costs associated with administration of the Z'Berg-Nejedly Forest Practice of 1973 (Chapter 8 (commencing with Section 4511) of Part 2).

b) (b) The Forest Resources Improvement Fund shall be the depository for all revenue derived from the repayment of loans made or interest received pursuant to Chapter 1 (commencing with Section 4790), and the receipts from the sale of forest products, as defined in Section 4638, from the state forests. Ten percent of the net state forest receipts from the sale of forest products, after the General Fund is reimbursed for costs of operating the state forests, is available, upon appropriation by the Legislature, for urban forestry programs pursuant to Chapter 2 (commencing with Section 4799.06) of this part.

c) (c) The director may accept grants and donations of equipment, seedlings, labor, materials, or funds from any source for the purpose of supporting or facilitating activities undertaken pursuant to this part. Any funds received shall be deposited by the director in the Forest Resources Improvement Fund. None of these funds received prior to the effective date of the act adding paragraphs (7) and (8) to subdivision (a) are available for the purposes of paragraph (7) or (8) of subdivision (a). (d) Each proposed expenditure by the department of money from the Forest Resources Improvement Fund shall be included as a separate item and scheduled individually in the Budget Bill for each fiscal year for consideration by the Legislature. These appropriations shall be subject to all of the limitations contained in the Budget Bill and to all other fiscal procedures prescribed by law with respect to the expenditure of state funds.

5820. This chapter shall be known and may be cited as the Mendocino Woodlands Outdoor Center Act.

5821. The Legislature finds that there is need for a program to enable the children of the state to better comprehend the outdoors, particularly the social and economic importance of the study, conservation, protection, and utilization of natural resources. The Legislature further finds that the location and facilities of the Mendocino Woodlands Outdoor Center are especially well suited to serve primarily as an outdoor education center under the control and management of the Department of Parks and Recreation, as a unit of the state park system.

5822. The Legislature hereby declares its intent that the Mendocino Woodlands Outdoor Center, consisting of land and facilities deeded to the State of California by the United States of America for public park, recreational, and conservation purposes, shall hereafter be maintained, provided, and operated for the benefit of the people of the state, primarily as an outdoor environmental education facility.

5823. As used in this chapter, unless the context clearly requires a different meaning:

a) "Department" means the Department of Parks and Recreation.

b) "Center" means the Mendocino Woodlands Outdoor Center, consisting of 720 acres, more or less, of state-owned land and improvements located within the east half of the Northeast Quarter and the east half of the Southeast Quarter of Section 13 of the east half and southwest quarter of the Northeast Quarter and the east half and southwest quarter of the Southeast Quarter of Section 24 of T. 17 N, R. 17 W., M.D.B.M.; the north half and southwest quarter of the Northwest Quarter and the north half of the Northeast Quarter of Section 18 of, and the west half of the Northwest Quarter of Section 30 of, T. 17 N., R. 16 W., M.D.B.M.

c) "Area" means the Mendocino Woodlands Special Treatment Area within the Jackson State Forest, consisting of 2,550 acres, more or less, of state-owned lands lying within the south half of Section 12 of; the Northwest Quarter, the west half of the Northeast Quarter, the west half of the Southeast Quarter, and the Southwest Quarter of Section 13 of, the Northeast, Southeast, and Southwest Quarters of Section 14 of, the northeast quarter of the Northeast Quarter of Section 22 of, the north half of Section 23 of, the Northwest Quarter, the northwest quarter of the Northeast Quarter, and the northeast quarter of the Southwest Quarter of Section 24 of, T. 17 N., R. 17 W., M.D.B.M.; and the Southwest Quarter of Section 7 of the southeast quarter of the Northwest Quarter, the south half of the Northeast Quarter, the northwest, northeast, and southwest quarters of the Southeast Quarter and the Southwest Quarter of Section 18 of, and the Northwest Quarter and the west half of the Southwest Quarter of Section 19 of, T. 17 N., R. 16 W., M.D.B.M.

5824. Jurisdiction and control of the center, consisting of 720 acres, more or less, and all the improvements thereon as described in subdivision (b) of Section 5823 is hereby transferred to the department from the Department of Conservation, and shall be administered as a unit of the state park system; except that access shall be provided through the center to the area, as described in subdivision (c) of Section 5823, for purposes of cutting timber under the authority of the State Forester exercised pursuant to Article 3 (commencing with Section 4645) of Chapter 9 of Part 2 of Division 4, in a manner acceptable to the State Forester. It is the intent of the Legislature that title in the aforementioned lands and facilities shall continue to vest in the State of California; and if for any reason their use for the purposes of this chapter be deemed by the department no longer to be in the public interest, then they shall be restored through future legislation to the jurisdiction and control of the Department of Conservation.

5825. The department shall prepare a plan for the protection and management of the center and shall submit the plan to the Legislature, for its consideration, no later than January 15, 1977. The plan shall include, but need not be limited to, the following considerations.

a) Means of ensuring the health, safety and comfort of center users while, at the same time, ensuring that the natural and rustic aspects of the center and its facilities are preserved.

b) The need for providing additional, all-weather lodging, dining and instructional facilities suitable for use by schoolchildren.

c) The protection and utilization of those resources of the center useful for outdoor study.

d) The suitability of the center for public uses, other than outdoor education, appropriate to the state park system.

e) The suitability of the continued use of the center by cultural, social, and youth organizations similar to those which have used the center prior to the effective date of this chapter.

f) The relationship of the center to the Jackson State Forest, Jughandle Creek, Pygmy Forest Park project, Big River project, Mendocino Headlands Park project, and other adjacent or nearby recreational, scientific, or scenic resources, so as to assure optimum public access, use, and enjoyment of such sites and resources.
g) The advisability of transferring or acquiring additional lands so as to ensure the administrative efficiency of the center.
h) The organizational and funding requirements of programs proposed to be undertaken at the center in accordance with this chapter.
i) Estimated utilization rates and the nature and level of fees necessary to make the center program essentially self-sustaining.

5826. The department shall consult with the Department of Education, and may cooperate with individuals and agencies having jurisdiction or expertise in matters pertaining to the outdoor education programs contemplated in this chapter.

5827. The department may enter into operating agreements with any qualified, nonprofit entity for the provision of any program or service contemplated in this chapter. Prior to entering into any such agreement, the department shall submit a copy of the proposed agreement to the Legislative Analyst for his review and recommendations, which shall not, however, be binding. Failure of the Legislative Analyst to respond within 30 days after submission of a proposed agreement shall be deemed to constitute approval by the Legislative Analyst of the proposed agreement.

5828. The department is encouraged to establish an advisory committee of persons interested and knowledgeable in the operation and nature of the center, and in the formulation and conduct of outdoor environmental education programs, to assist it in formulating the plan and actions contemplated in this chapter.

5829. Prior to authorizing the sale and cutting of timber from the area described in subdivision (c) of Section 5823, the State Forester shall solicit and consider the recommendations of the Department of Parks and Recreation with respect to the prevention of unnecessary or unreasonable interruption or loss of facilities or resources essential to center operations.

2. CALIFORNIA CODE OF REGULATIONS

Chapter 9. State Forests-Use and Sales (Formerly Subchapter 8, 9, and 9.1 of Chapter 2, Division 2, Title 14, Cal. Adm. Code.)

Subchapter 1. Recreational Use

Article 1. Abbreviations and Definitions

§ 1400. Abbreviations.

The following abbreviations are applicable throughout this Chapter.
a) B&M Baseline and Meridian reference lines running in true EW and NS directions used in U. S. General Land Survey
b) CAC: California Administrative Code.
c) cm: Centimeter(s)

d) E: true cardinal direction East
e) ha: hectare(s)
f) M: meter(s)
g) MD: Mount Diablo (used in combination with B&M
h) N: true cardinal direction North
i) PRC: Public Resources Code
j) R : Range : a row of townships, six miles in width, between two successive meridian lines of the U. S. General Land Survey
k) S: true cardinal direction South
Sec.: Section
T: Township: a tier of ranges, six miles in length between two successive standard parallels as used in the U. S. General Land Survey
W: true cardinal direction West
Note: Authority cited: Section 4656.1, Public Resources Code. Reference: Section 4656.1, Public Resources Code.

§ 1400.5. Definitions.

The following definitions are applicable throughout Chapter 9 unless the context clearly requires otherwise.

a) "Affiliate" means the purchaser's subsidiary, parent company, joint venture partner, entity, being a portion of the conglomerate of which the purchaser is a unit, or other entity under the purchaser's indirect control.
b) "Board" means the California State Board of Forestry and Fire Protection.
c) "Campfire" means a fire used by one or more persons while camping, picnicking, recreating or working on state forest land, to provide any one or combination of the following: heat for cooking, heat for personal warmth, light and for ceremonial or aesthetic purposes. "Campfire" includes open fires and those fires contained within fireplaces and enclosed stoves with flues or chimneys, stoves using pressurized liquid or gaseous fluids, portable barbecue pits and braziers or space heating devices which are used outside any structure, trailer house or living accommodations mounted on a motor vehicle.
d) "Camping" or camp means erecting a tent or shelter or arranging bedding or both, for the purpose of, or in such a way as will permit remaining overnight; or occupying an established campsite with a camper vehicle or camping equipment for the purpose of reserving the use of such campsite. The term also includes parking a camper vehicle or trailer and spending the night within, or within close proximity of said camper vehicle or trailer.
e) "Designated camping area" means a location designated by the state forest manager as a camping area and marked by authorized signs to that effect. Unless otherwise delineated by fences or signs, a "designated camping area" shall include only the area developed for camping and provided with fireplaces or tables or both, and shall not include any adjacent areas not so developed for camping.
f) "Department" means the California Department of Forestry.
g) "Director" means the Director of Forestry.
h) "person" means and includes natural persons, firms, co-partnerships, corporations, clubs, and all associations or combinations of persons whenever acting for themselves, by agent, servant, or employee.
i) "Purchaser" means that person, company or entity who was the successful bidder, buyer, transferee or successor of state timber.

j) "State forest" or forest means any portion of the state forest system administered by the Director.

k) "State forest licensee" means any person authorized by a state forest manager or the superiors thereof, to engage in any of the following activities within a state forest:
   (i) operate concessions serving the public.
   (ii) plant, protect, harvest or remove timber, or other forest products or minerals.
   (iii) conduct experiments or otherwise engage in research or educational activity.
   (iv) Or any other activity not listed above with written permission of the Director.

l) "State forest manager" means the state forest officer appointed by the Director to supervise the management and administration of a state forest or in the state forest manager's absence, the person designated by a state forest manager to act during his or her absence.

m) "State forest officer" means employees of the Department of Forestry as designated by the Director, or such other persons as may be designated by the Director.

n) "State timber" means any or all trees, logs or wood products from state-owned forests, which have not received primary manufacture to a size sawn on 4 sides to dimensions of 4 inches by 12 inches (10.2 cm by 30.5 cm), or less.

o) "Substitution" means the replacing of state timber for unprocessed timber which, directly or indirectly, was exported to a foreign country from private lands owned or controlled by the purchaser within California in an area 200 miles (321.8km) or less from the nearest boundary line of the state timber sale area from which state timber was removed. The distance will be determined via the shortest route of either public roads, railroads, or water route customarily used to transport forest products.

p) Note: Authority cited: Section 4656.1, Public Resources Code. Reference: Section 4656.1, Public Resources Code.

ARTICLE 2. Camping Area Use

§ 1401. Camping Area.

Camping in state forests is restricted to designated camping areas. No person shall camp outside of a designated camping area unless that person or someone in attendance has in their possession a valid state forest campfire and special use permit. Failure to comply with the terms and conditions set forth on said permit shall render it invalid for purposes of this Section.

§ 1402. Campfire Permits.

a) No person shall prepare, ignite, maintain or use a campfire in any place other than a designated camping area unless that person or someone in attendance has in their possession a valid state forest campfire and special use permit. Failure to comply with the terms and conditions set forth on said permit shall render it invalid for purposes of this Section.

b) No person shall prepare or ignite a campfire which is or will be unreasonably large and/or dangerous to the surrounding land, or maintain such a fire after having been ordered by a state forest officer to reduce or extinguish it.

c) No person shall leave a campfire ignited, maintained or used by that person unattended.

§ 1403. Occupancy Time Limits.
No person shall camp within any one state forest more than 14 days in any single visitation. Consistent with Section 4455 of Title 14, California Code of Regulation, General Occupancy by the same persons, equipment, or vehicles of any camping facility is limited to a total of 30 days in any calendar year in that State Forest. Exceptions may be granted by the state forest manager to persons engaged in official state business.

Note: Authority cited: Section 4656.1, Public Resources Code. Reference: Sections 4643, 4645, 4646 and 46546.2, Public Resources Code.

§ 1404. Reservations.
Individual campsites may not be reserved. The term "reserved" includes, but is not limited to, calling or writing in advance to obtain a campsite, a person occupying one or more campsites temporarily until another party arrives, placing camping equipment in a campsite prior to actual occupancy by another party, or other means of obtaining a campsite for a person or persons not actually present in the state forest.

§ 1405. Conduct.
No person shall use threatening, abusive, boisterous, insulting or indecent language or make any indecent gesture in a state forest at such times and in such locations as to disturb other persons; nor shall any person conduct or participate in a disorderly assemblage. Clothing sufficient to conform to common standards of decency shall be worn at all times when the wearer is subject to public view.

§ 1406. Assembly.
No person shall conduct a public assembly or demonstration except on permission of the state forest manager upon finding that the time, place and manner of such activity would not substantially interfere with the use of the state forest by the general public in the applicable area.

Note: Authority cited: Section 4656.1, Public Resources Code. Reference: Sections 4656.1 and 4656.2, Public Resources Code.

ARTICLE 3. GENERAL RESTRICTIONS

§ 1410. Nuisance.
No person shall erect any structure on or allow a campsite occupied by that person to become littered with refuse.

§ 1411. Equipment.
No person shall occupy a site with camping equipment or vehicles prohibited by the state forest manager.

§ 1412. Noise.
No person shall create noise which disturbs others in sleeping quarters or in campgrounds within a state forest between the hours of 11 p.m. and 6 a.m. daily. No person shall, at any time, use electronic equipment (other than that used in forest operations) including electrical speakers, radios, phonographs, or televisions which produces a sound that can be heard at more than 100 feet from the source.

Note: Authority cited: Section 4656.1, Public Resources Code. Reference: Sections 4656.1 and 4656.2, Public Resources Code.

§ 1413. Weapons.
(a) No person shall discharge any firearm, air or gas weapon, or bow and arrow in the vicinity of camps, residence sites, recreation grounds and areas, and over lakes or other bodies of water adjacent to or within such areas, whereby any person is exposed to injury as a result of such discharge.
(b) Without limiting the foregoing, no person shall discharge any of the above named weapons or any other weapon while within 150 yards (137.20 m) of any designated camping area.

§ 1414. Soliciting.
No person shall sell or offer for sale any goods or services within a state forest unless licensed by the state forest manager.

Note: Authority cited: Section 44656.1, Public Resources Code. Reference: Sections 4656.1 and 4656.2, Public Resources Code.

§ 1415. Firewood.
Campers, picnickers and other recreational users may gather dead wood lying on the ground for use within the state forest. No person shall remove firewood or other forest products from any state forests without the written consent of the state forest manager.

§ 1416. Defacing Plants.
a) No person shall cut or deface live trees, or remove shrubs, plants or portions thereof, or destroy, deface or remove forest products of any description.
b) Annual fruits of native plants such as gooseberries, elderberries and blackberries may be picked and empty conifer cones may be taken for non-commercial use.
c) This section shall not apply to state forest licensees when acting within the scope of their authorization.

§ 1417. Geological Features.
No person shall destroy, disturb, mutilate or remove earth, sand, gravel, oil, minerals, rocks or features of caves. This Section shall not apply to state forest licensees when acting within the scope of their authorization.

§ 1418. Horticulture.
In order to control soil erosion, conserve water and preserve the natural condition of state forests, no person shall plant, tend or harvest within a state forest any herbs, flowers, vegetables, or fruits except as permitted by Section 1416(b). This section shall not apply to state forest licensees when acting within the scope of their authorization.

§ 1419. Improvements.
No person shall mutilate, deface, damage or remove any table, bench, building, sign, marker, monument, fence barrier, fountain, faucet, gate, lock, water storage tank or other structure, facility, equipment or property within a state forest.

§ 1420. Unauthorized Signs.
No person shall cut, carve, paint, post or otherwise affix in a state forest any bill, advertisement or inscription on any tree, natural geologic formation, fence, wall, building, monument or other property whether improved or unimproved. This section shall not apply to state forest licensees when acting within the scope of their authorization.

§ 1421. Rubbish.
(a) No person shall leave, deposit, drop or scatter bottles, broken glass, ashes, waste paper, cans or other rubbish in a state forest except in a receptacle designated for that purpose.
(b) Without limiting the foregoing, no person shall vacate campsite without removing all of the above-mentioned refuse thereon and depositing it in a receptacle designed for that purpose.

§ 1422. Polluting Waters.
No person shall deposit, permit to pass into, or willingly allow ay substance in any spring, stream, lake or other waters within a state forest which will tend to cause said waters to become unfit for human consumption, deleterious to fish and plant life, or which will destroy the aesthetic qualities of the waters. This section includes, but is not limited to, the washing of clothing or other materials, and the disposal of body or other wastes.

§ 1423. Animal Waste.
Persons keeping dogs, cats, or other animals within designated camping areas are responsible for removing and burying any and all droppings of said animal, and failure to do so within a reasonable time, or upon order of a state forest officer, shall constitute a violation of this Section.

§ 1424. Pets.
(a) No person shall bring a dog, cat or other animal into a designated camping area unless is it confined, or in a vehicle, or upon a leash not longer than 6 feet (1.83 m), or otherwise under physical restrictive control at al times.
(b) No person shall keep within a state forest a dog or other animal which is noisy, vicious, dangerous or disturbing to other persons after having been ordered by a state forest officer to remove said animal from the state forest.

§ 1425, Horses.
a) No person shall bring saddle, pack or draft animals into a designated camping area unless it has been developed to accommodate them and is posted accordingly.
b) No horse or other animal shall be hitched to any tree, shrub or structure in such a way that it may cause damage thereto.
c) Persons bringing animals into a state forest are responsible for providing them with feed, and no person shall allow any saddle, pack or draft animal to graze on any portion of the state forest not specifically designated by the state forest manager as suitable for grazing purposes.

§ 1426. Smoking.
Smoking on state forest land covered with flammable vegetation or ground litter while traveling on foot, cycle or domestic animal is prohibited between April 1 and December 1 of any year, and in areas posted against smoking. Smoking is permitted in the following locations: Within improved campground, inside vehicles on improved roads, in places of habitation, and while stopped in an

area of at least 3 feet (0.91 m) in diameter cleared of flammable vegetation and ground litter, provided however when smoking within a 3 foot (0.91 m) clearing that all glowing substances are extinguished and discarded within the cleared area.

§ 1427. Archeological Features.
No person shall collect or remove any object or thing of archeological or historical interest or value, nor shall any person injure, disfigure, deface or destroy the physical site, location or context in which the object or thing of archeological or historical interest or value is found.
Note: Authority cited: Section 4656.1, Public Resources Code. Reference: Sections 4656.1, 4656.2 and 4656.3, Public Resources Code.

ARTICLE 4. VEHICLES

§ 1430. Parking Time Limits.
The state forest manager may by order establish limits of time for the parking, storage, or leaving of vehicles, including trailers, in a state forest and in units or portions thereof. No person shall so park, store or leave a vehicle or trailer in contravention of such orders when such time limits have been posted in the area affected. Nothing herein shall be construed in derogation of other state forest regulations.

§ 1431. Cross-Country Travel Prohibited.
Motor vehicles shall be operated only on roads and in parking areas constructed for motor vehicle use. Trail bikes, motorcycles, jeeps, pickups, and other passenger-carrying motor vehicles shall not be operated on any road or trail posted as closed to the public or to such use.

§ 1432. Speed Limits.
History
1. Repealer filed 2-1-83; effective thirtieth day thereafter (Register 83, No.6).

§ 1433. Vehicles In Camping Areas.
No person shall drive any motorbike, motorcycle or other motor vehicle on any roads within designated camping areas for any purpose other than access to, or egress from the area.

ARTICLE 5. Restricted Use Areas

§ 1435. Areas Closed to Hunting, Trapping, and the Use of Firearms.
The following areas are closed to hunting, trapping, and the use of firearms.

a) Area in Tulare County.
The area approximately 440 acres (178.068 ha), more or less, located in Tulare County and described as follows: lying north, south, east and west of Balch Park being those parts of Sec. 36, T19S, R 30E, Sec. 31, T19S, R31E, Sec. 6T20S, R31E, and Sec. 1 and 2, T20S, R30E, that are bounded as follows: from the intersection of the north line of said Sec. 1 with the Balch Park road northerly along this road to its junction with the Lace Meadow road; thence easterly along said Lace Meadow road to its intersection with the north line of the SE ¼ of Sec. 36, T19S, R30E; thence east along said line to the Summit road; thence southerly along the Summit road to its junction with the Balch Park road; thence

southwesterly along the Balch Park road to its junction with the Bear Creek road; thence southwesterly along the Bear Creek road to its intersection with the south line of Sec. 2 to the old Coburn Mill road; thence along the Coburn Mill road to its intersection with the north line of the SE ¼ of Sec. 2 to the quarter corner between Sec. 1 and 2; thence along the west and north lines of the SE ¼ of the NW ¼ of Sec. 1 to the SW corner of the Balch Park property; and thence easterly and northeasterly, thence easterly, thence northerly, thence westerly, thence southerly, and finally westerly along the boundaries between Balch Park and the Mountain Home State forest to the point of beginning. All townships are described from the MDB&M.

b) Area in Mendocino County:

The areas located in Mendocino County and described as follows:

1) Mendocino Woodlands area, approximately 3,000 acres (1214.100 ha), more or less. That portion of Mendocino Woodlands area laying south and east of the Little Lake Mendocino (city) road, and south of Jackson State Forest road 740, being all of Sec. 13 and portions of Secs. 1, 11, 12, 14, 15, 22, 23, and 24 of T17N, R17W, and portions of Secs. 7, 18, 19 and 30 of T17N, R16W, all MDB&M.
2) Parlin Fork Conservation Camp area, approximately 1,500 acres (607.500 ha), more or less. The E ½ of Sec. 32, T18N, R16W, MDB&M. All of Secs. 33, T18N, R16W, MDB&M. That portion of Sec. 4, T17N, R;16W, MDB&M, lying north of state highway 20.
3) Chamberlain Creek Conservation Camp area, approximately 1,020 acres (412.794 ha), more or less. All of Sec. 5, T17N, R15W, MDB&M; N ½ of Sec. 8, T17N, R15W, MDB&M: N ½ of Sec. 9, T17N, R15W, MDB&M.

§ 1436. Areas Closed to Hunting and the Use of Firearms.

The following area is closed to hunting and the use of firearms:

a) Area in Shasta County.

The area of approximately 320 acres (129.504 ha), being a portion of the Latour State Forest immediately surrounding the Latour Forest Headquarters and Forest Fire Station. Said lands being located in Shasta County and being described as follows: lying south and east of Mc Mullen Mountain being the SE ¼ of Sec. 1 and the NE ¼ of Sec. 12, T32N, R2E, MDB&M.

§ 1437. Fire Hazard

History

1. Repealer filed 2-1-83; effective thirtieth day thereafter (Register 83, No. 6).

§ 1438. Temporary Restricted Use.

To insure the safety and health of persons, to avoid interference in development, construction, research and timber management, or to provide for the security, safeguarding and preservation of property within a state forest and portions thereof, a state forest manager or the period of time not to exceed 1 year.

a) Notices prescribing the prohibited activity shall be posted in such locations as will reasonably bring them to the attention of the public.
b) No person shall, while in the restricted area, engage in the activity so prohibited.

§ 1439. Temporary Restricted Use.

To insure the safety and health of persons, to avoid interference in development, construction, research and timber management, or to provide for the security, safeguarding and preservation of

property within a state forest and portions thereof, a state forest manager or the superiors thereof may order any portions of a state forest closed to public use or entry for a period of time not to exceed 1 year.

a) A copy of the order shall be posted at the state forest headquarters and may specify such reasonable classes of persons who may enter the closed area in the conduct of such proper activities or official duties as the forest manager or the superiors thereof may prescribe.

b) Notices designating the area closed to entry shall be posted in such locations as will reasonably bring them to the attention of the public. Such notice may specify the period or periods of closure.

c) During this period when an area is closed to public entry, only persons specifically authorized by the order of closure may enter or remain within the area so closed.

This section shall not be construed in derogation of any other state forest regulation.

Subchapter 3. Geothermal Development

Article 1. Purpose

§ 1500. Purpose.

History

1. Repealer of subchapter 3, article 1 (section 1500) and section filed 11-7-96; operative 1-1-97 (Register 96, No. 45).

Article 2. Specific Provisions

§ 1501. General Requirements.

History

1. Repealer of subchapter 3, article 2 (sections 1501 through 1503) and section filed 11-7-96; operative 1-1-97 (register 96 No. 45).

§ 1502. Special Requirements.

History

1. Repealer filed 11-7-96; operative 1-1-97 (Register 96, No. 45).

§ 1503. Consent of Permits or Leases.

1. Repealer filed 11-7-96; operative 1-1-97 (Register 96, No. 45).

Subchapter 4. Timber Sales

§ 1510. Harvesting and Management.

The harvesting of forest products from state forests and management of state forests shall follow management plans developed for each forest by the Director, and approved by the Board.

Note: Authority cited: Section 4656.1, Public Resources Code. Reference: Sections 4656, 4651, and 4656.1, Public Resources Code.

§ 1511. Timber Sales.
When selling timber from state forests as authorized by PRC 4650-4651, the Director shall comply with the requirements of the Department of General Services and Department of Finance pertaining to the sale of state property. Such timber sales shall be conducted and administered by the Director following procedures promulgated in the State Administrative Manual (SAM) for contracting and sale of state property.
Note: Authority cited: Section 4656.1, Public Resources Code. Reference: Sections 4651 and 4656.1, Public Resources Code.

§ 1515. Bids Solicitation.
The Director, when selling or soliciting bids for sale of timber form state forests, shall condition the sale upon agreement of the purchaser that said timber will not be substituted for timber exported from private lands under control of the bidder, or affiliate.

§ 1516. Non-Substitution Agreement.
Every purchaser of timber from state forests shall execute an agreement with the Director that said timber will not be substituted for timber exported from the purchaser's private land.

§ 1517. Notice of Removal.
The purchaser, before removal of timber from state forests, shall give written notice to the Director of any or all locations where said timber will be processed. Said notice shall be required for all of said timber until such time as the timber has been sawn to dimensions of 4 inches by 12 inches (10.2 cm by 30.5 cm) or less.

§ 1518. Transfer Requirement.
Upon transfer of state timber not receiving primary manufacture, the purchaser shall require the transferee to agree to the same substitution restrictions as are imposed on purchaser. Within 5 days of said transfer, a copy of the agreement, together with location of intended processing of said timber, shall be delivered by purchaser to the Director.

§ 1519. Preservation of Records.
Purchaser shall preserve for a period of 3 years, after conclusion of removal of timber from the state forest, all records pertaining to the use and disposition of the state timber and, upon request of the Director, make said records available for inspection by the Director.

§ 1520. Violation.
History
1. Repealer filed 2-1-83; effective thirtieth day thereafter (Register 83, No. 6).

§ 1521. Notice of Violation and Review.
If the Director determines that a purchaser has violated any provision of these regulations, a Notice of Violation shall be sent certified mail to purchaser with the further statement that purchaser shall be prohibited from purchasing state timber for a period of 5 years from the date of violation and said notice will designate the period of suspension of the timber operator permit, if any, not exceeding a period of 6 months from the date of notice. Within 30 days of said notice, purchaser may make written appeal to the Director for review. The Director, upon his or her option, may act on the appeal either by open hearing or submission of written documents and proof. A decision of the Director is final.

3. BOARD OF FORESTRY AND FIRE PROTECTION POLICIES

CHAPTER 0310 - BOARD POWERS AND RESPONSIBILITIES

GENERAL POWERS AND RESPONSIBILITIES 0311

- Included within the function of the Board of Forestry and Fire Protection is the power and responsibility to:
- Represent the State's interest in the acquisition and management of State forests;

COOPERATIVE AGREEMENTS, NURSERY, INSECT CONTROL, LAND GIFTS 0315
Board powers and responsibilities include:

- Recommend and, if necessary, set conditions for accepting gifts of land for the State Forest System;

STATE FORESTS 0316
Board powers and duties regarding State forests include:

- Determine approval of Department of Forestry forest management plans in State forests;
- Recommend and promulgate resolutions for acquisition of State forest properties if it is deemed appropriate;
- Determine approval of State forest land sales due to unsuitability for forest purposes;
- Establish rules for the preservation, protection, and use of State forests.

LAND AVAILABILITY 0334.3

In order to maintain timber growing land in California as a permanent source of current and future timber supply, the Board has found that it is in the public interest:

B. To manage all prime timberland on State forests to investigate and demonstrate management for optimum long-run timber production. Where such forest lands contain or adjoin areas of high recreation value in State or other ownership, timber growing and harvesting practices may be modified in order to minimize conflicts between other land uses and to demonstrate the costs and effectiveness of such practices.

CHAPTER 0350 - FOREST MANAGEMENT POLICIES

STATE FORESTS 0351

GENERAL 0351.1

California's State forest system has been in existence since 1946 when the first large forest properties were acquired. Sections 4631-4658 of the Public Resources Code provide the authority for acquisition, administration, and operation of State forests by the Department. Most of these statutes were enacted in 1945 following recommendations of the Forestry Study Committee established by the Legislature in 1943. There are now seven State forests totaling 68,654 acres as shown below:

STATE FORESTS IN CALIFORNIA - 1982

State Forest	County	Area (Acres)	Date Acquired
Jackson	Mendocino	50,505	1947-51, 1968
Latour	Shasta	9,013	1946
Mountain Home	Tulare	4, 562	1946
Boggs Mountain	Lake	3,454	1949, 1972
Las Posadas	Napa	796	1929 (gift)
Mount Zion	Amador	164	1932 (gift)
Ellen Pickett	Trinity	100	1939 (gift)

Jackson, Latour, Mountain Home, and Boggs Mountain State Forests are commercial timberland areas managed by professional foresters who conduct programs in timber management, recreation, demonstration, and investigation in conformance with detailed management plans. Las Posadas, Mount Zion, and Ellen Pickett State Forests were acquired as gifts to the State and are relatively noncommercial in nature. These smaller forests are used primarily for administrative and recreational purposes and are managed by local Department of Forestry personnel incidental to other responsibilities. Deed restrictions preclude some uses on these forests.

A large acreage of potentially productive timberland in California is not producing a satisfactory growth of young timber. To attain proper management of private timberlands in California, there is a need to investigate, develop, and demonstrate new and improved forest management methods to timberland owners and the public. The State forests serve this purpose while contributing to the economic stability of local communities by providing high yields of forest products which sustain local employment and tax bases. Outdoor recreation is an important public benefit of the state forests.

The significance of the State forest program in demonstrating improved practices will increase as the demand for forest products increases and as public interest in forest management practices intensifies. Demonstrations of the compatibility and conflicts involved in multiple use of forest land are essential as population and development pressures increase on California's forest lands.

The State forests require a stable land base to facilitate long range planning necessary in forest land management. There is an urgent need to preserve the integrity of the existing State forests to assure their continued management according to legislative intent contained in PRC Section 4631. Reduction of private and public inholdings through purchase or exchange is needed to allow more efficient management of the existing State forests. Additional small demonstration forests (under 2,000 acres) adapted to meeting local requirements for investigation, demonstration, and education

are needed in those counties where management of small timber ownerships is inadequate and no demonstration forests exist. There may be lands already in State ownership that could partially meet this need.

In consideration of the above facts, the Board of Forestry and Fire Protection has adopted the following policies to guide the Department of Forestry in administering the State forest program and managing the State forests.

PROGRAM PURPOSE AND LAND USE PRIORITIES 0351.2

The primary purpose of the State forest program is to conduct innovative demonstrations, experiments, and education in forest management. All State forests land uses should serve this purpose in some way. In addition:

A. Timber production will be the primary land use on Jackson, Latour, and Boggs Mountain State Forests. Timber production will be subordinate to recreation on Mountain Home State Forest;

B. Recreation is recognized as a secondary but compatible land use on Jackson, Latour, and Boggs Mountain State Forests. Recreation is a primary use on Mountain Home State Forest as prescribed by Section 4658, Public Resources Code:

C. State forest lands may be used for Department administrative sites when such use will benefit State forest programs or protection;

D. Special uses primarily benefiting non-forestry and/or private interests will have low priority. Such uses that conflict with State forest objectives are discouraged.

DEMONSTRATIONS AND EXPERIMENTS 0351.3

The Board, consistent with PRC Section 4631, recognizes and reaffirms that the primary purpose of State forests is to conduct demonstrations, investigations, and education in forest management. The Board wishes to emphasize and expand demonstrational, experimental, and educational activities on the State forests. Accordingly, in the operation of State forests, the Department will:

A. Conduct a balanced program of demonstrations and investigations in silviculture, mensuration, logging methods, economics, hydrology, protection, and recreation; directed to the needs of the general public, small forest landowners, timber operators and the timber industry.

B. Continue and develop procedures to assure dissemination of information obtained on State forests to forest landowners, (especially small owners), timber operators, and the general public.

C. Integrate the Department's Service Forestry Program with State forest demonstration activities to more effectively reach small forest landowners and the general public.

D. Conduct periodic field tours to exhibit State forest activities and accomplishments to forest industry, small forest landowners, relevant public agencies, and the general public. Field

tours should be initiated by the Department and conducted at such times and places to encourage general public attendance.

E. Seek special funding as needed from the Legislature to support specific research projects on State forests.

F. Consult with and solicit the cooperation of the State universities and colleges, U.S. Forest Service, and other public and private agencies in conducting studies requiring special knowledge. Enter into cooperative agreements with other public and private agencies for investigating forest management problems of mutual interest. It is particularly of mutual benefit to make the State forests available to educational institutions, and other agencies for research projects.

G. Cooperate with the Department of Parks and Recreation in establishing forest management demonstration areas compatible with recreation for educational purposes adjacent to the Mendocino Woodlands Outdoor Center on Jackson State Forest.

TIMBER MANAGEMENT 0351.4

Purposes and policies for timber management on state forests are established in PRC Sections 4631 and 4651. The Board has further established the following policies pertaining to management and harvest of timber on State forests:

A. The Department will conduct regular periodic timber sales on Jackson, Latour, Boggs Mountain, and Mountain Home State Forests. Harvesting may be deferred in accordance with an approved management plan;

B. A rotation age, cutting cycle, and an allowable annual cut will be established for each State forest from which timber is harvested. Timber harvesting schedules should be projected at least five years into the future;

C. Allowable cut levels must be derived from pertinent current inventory and growth data;

D. State forest timberlands will be managed on the sustained yield principle, defined as management which will achieve and maintain continuous timber production consistent with environmental constraints;

E. State forest timber stands should be harvested on the basis of maximizing mean annual increment of high quality forest products. This should not preclude intermediate cuts designed to increase total yield and reduce losses from mortality;

F. Timber production and harvesting should provide for coordination with other State forest uses. Silvicultural practices should be compatible with recreation, soil, water, wildlife, and fishery values, and aesthetic enjoyment;

G. Economically and ecologically justifiable intensified forest management practices to increase total fiber production and timber quality will be pursued on the State forests. These practices will be designed and carried out for maximum applicability (or demonstration

values) to private lands. Financing to conduct such intensive silvicultural practices should be actively sought by the Department;

H. Timber sales should have demonstrational value and include experimental and educational aspects whenever possible.

RECREATION ON STATE FORESTS 0351.5

A. Recreation is recognized as a secondary, but usually compatible use, on Jackson, Latour, and Boggs Mountain State Forests. Recreation is a primary use on Mountain Home State Forest as prescribed by section 4658, Public Resources Code.

B. The recreation program on State forests will make camping and day use facilities available to the general public, offer a degree of control and protection to the forests, and demonstrate that recreational use and timber management can be compatible land uses.

C. Campgrounds, picnic areas, and trails will be developed on State forests, as funds become available, but only consistent with the recreational carrying capacity as determined in the management plan.

D. Recreation improvements will generally be rustic in character with sanitary facilities and water sources which meet public health requirements. Special attention should be given to maintaining safe and sanitary conditions in all recreation sites utilized by the public.

E. Recreation use will be integrated with timber management activities to demonstrate how these uses can be compatible. The presence of recreationists on the State forests presents a unique opportunity to explain timber management to the general public.

F. The State forests will remain open for public hunting and fishing in accordance with State Fish and Game regulations except for specified closures required for public safety and forest protection as authorized by law.

SPECIAL USES OF STATE FORESTS 0351.6

Special uses of State forests will be permitted only when there is a clear benefit to the State and when such uses do not conflict with primary (uses) programs of timber management, demonstration, research, and recreation.

A. Use of State forests for mining, grazing, and commercial concessions is discouraged.

B. Although the state Lands commission has primary jurisdiction over geothermal resources on state forests, surface operations of geothermal developers will be strictly controlled by the department in accordance with regulations adopted by the Board contained in 14 CAC Section 1500-1503.

GRANTING TEMPORARY PERMITS FOR PASSAGE 0351.7

It is desirable to grant temporary permits for passage across State forests to forest products operators or other parties having need of them in the course of their operations where such permits do not interfere with the primary uses of State forests by the State. Applications for temporary permits for passage may be made to the Director who will be guided by the following principles in submitting applications to the Director of General services for approval.

A. Temporary permits for passage will be granted on a reciprocal basis where practicable.

B. The State will have free use of all lands and routes over which permits for passage have been granted.

C. The State will reserve the right to cross, recross, and parallel any such lands or routes with its own roads or utilities.

D. Temporary permits for passage will be limited to a minimum economical width but in no case shall exceed 60 feet except for needed cuts and fills.

E. The grantee of any temporary permits for passage will pay the State the current market value of timber necessarily cut or damaged in clearing and construction on State lands, provided that the price and volume will be determined by the Director, and such timber when paid for will belong to the operator.

F. Temporary permits for passage will be of such duration as to meet the reasonable needs of the grantee. Three years' non-use of any permit for passage for the purpose granted will constitute an abandonment forfeiture thereof unless the period of non-use is otherwise agreed upon.

G. The State will be reimbursed for any damage caused to State property in the construction and/or maintenance of such, provided that the grantee will hold the State harmless from any and all liability arising from the construction, maintenance and/or use of areas covered by such permits for passage.

H. Where it appears that benefit will result to the State, any charge for such permit for passage may be reduced accordingly.

I. All slash and snags on the area covered by a permit for passage will be disposed of by the grantee. The grantee will have the same responsibility for fire protection on any such area as is required by the Board for fire protection on a timber operating area.

PERMANENT EASEMENTS ACROSS STATE FOREST LANDS 0351.8

Permanent easements across State forest lands are sometimes necessary to allow adjacent owners access, use and development of their property. Granting of permanent easements across State forest lands can influence the development of subdivision or rural residential complexes which are not in harmony with State forest management activities.

The Board does not support or encourage residential development within State forest boundaries or on lands contiguous with State forest boundaries. The following guidelines will be followed by the Director in considering request for permanent easements:

i. Requests for permanent easements and widening of existing easements will be discouraged, but may be considered when no other routing through non-State forest land is physically possible or if such other routing presents substantial and unreasonable difficulties or environmental damage;

ii. Requests for permanent easements will be submitted by the applicant in complete and understandable form with appropriate engineering data and plats as may be required by the Director. The applicant will prepare any required environmental documents and bear all administrative costs associated with processing his easement agreement;

b. Requests for permanent easements will be accompanied by a non-refundable deposit to cover administrative and engineering costs involved in studying the request. The deposit will be applied toward any fees charged if an easement agreement is consummated. This non-refundable deposit will be forfeited by the applicant if for any reason an easement agreement is not granted by the State. All fees may be waived where reciprocity is a consideration;

B. In those special cases where permanent easements are necessary for subdivision rural residential development, the easement will be accepted by the county as part of the public road system and developed to public road system standards;

C. To prevent proliferation of roads and easements, parcels with multi-ownerships will be required to share a common easement across State forest lands if at all feasible. This may involve substantial increases in planning, negotiation, engineering and cost to the original applicant;

D. To maintain control of easement use which could lead to subdivision rural residential development, an effort will be made to formalize by agreement, any prescriptive rights to State forest roads which adjacent owners may have acquired through uncontested use;

E. Permanent easement requests will be considered for only the minimum width and minimum development needed for the requested use;

F. A clause will be included in all permanent easement agreements guaranteeing the State all forest management options in areas adjoining privately developed lands without interference from the grantee;

G. I The Director will record all permanent easement agreements with the local county.

STATE FOREST LAND ACQUISITION POLICY 0351.9

A. The State forests should remain intact as management units without further diversion of productive area to non-forestry purposes. There should be no future transfers of commercial timberland from the state forests except where such transfers meet the program objectives of the State forests.

B. Private and public inholdings within the State forests should be reduced through acquisition or exchange. Irregular property lines should be rectified by acquisition or exchange, where desirable, to facilitate efficient management and to avoid conflicting land uses on adjacent areas. Inholdings and irregular property lines present an especially acute problem on Mountain Home State Forest which should be resolved as soon as possible. Certain boundary line adjustments would also be desirable on Jackson and Latour State Forests.

C. Public Resources Code Section 4631(c) permits acquisition of "Demonstration forests of 2,000 acres or less adapted to furnish local needs of investigation, demonstration, and education in those timber counties where the ownership pattern is such that management of small areas is an important problem." Existing Department administrative sites involving significant timberland areas should be analyzed to determine if they could be utilized as demonstration state forests. Las Posadas, Mount Zion, and Ellen Pickett State Forests should be studied to determine if they contribute to the State forest program, or if they should be sold or exchanged for areas more suitable for State forest purposes.

STATE FOREST MANAGEMENT PLANS 0351.10

Management Plans for Boggs Mountain, Jackson, Latour, Mountain Home and Soquel Demonstrations State Forests shall be prepared by the Department, with appropriate public review, for approval by the Board. The Department shall present to the Board a thorough review of each existing plan at least every five years. After each review, the Board may direct the Department either to continue management under the existing plan, to prepare amendments to the plan, or prepare a new plan for public review and Board approval. The Department shall submit the requested amendments or plan to the Board within one year after each request. The Department shall continue management under existing plans with appropriate consideration for changes in law or regulation, until amendments or new plans are approved by the Board.

APPENDIX 6
CALIFORNIA DEPARTMENT OF FORESTRY AND FIRE PROTECTION PROJECT SCOPING REPORTS

JDSF PRELIMINARY DRAFT: PUBLIC AND SFAC COMMENTS AS OF OCTOBER 1, 2001

SIERRA CLUB CALIFORNIA (JULY 10, 2001) BY KATHY BAILEY

1. The plan should provide a greater degree of specificity to allow the public to better evaluate the existing resources and how CDF intends to manage them.

GENERAL INTENT OF BOARD POLICY

2. Non-timber resources should be considered as forest "products", falling under the Board's general direction that the "primary purpose of the State forest program is to conduct.....forest management". Much of the public wants JDSF to conduct research and demonstrations in relation to the full array of forest products, including optimizing water quality, fish and wildlife production, recreation, and aesthetic enjoyment. The plan is geared around timber harvest, with no forest management demonstrations (except a few LWD studies) proposed except in relation to timber production as the primary goal.
3. Based on personal experience, more than half of the small forest land owners are not managing their lands for timber production. They need demonstrations in subjects of interest to them, including non-timber issues (wildlife and water quality).

OLD-GROWTH, LATE SERAL, AND OLDER SECOND-GROWTH STANDS

4. The tiny old-growth reserves are highly concentrated in a few areas, and do not connect in a meaningful way.
5. It is vital to maintain a significant portion of JDSFs mature forest stands that are younger than old growth.
6. There should be more extensive late seral development areas, including much larger riparian management areas. These could become the core recreation use areas of the forest.
7. The plan should include a map that clearly indicates existing old forest stands. The existing forest vegetation map does not provide enough information. The largest size class indicated (18 inches) is not likely to be very old.
8. A more precise definition of late seral should be included (suggestion provided in the letter). This is needed to help facilitate discussion of late seral development areas and for defining conditions we may hope to achieve in the riparian management zones.
9. Table 6 should separately tabulate true old growth, retained late seral stands, and late seral development areas in the body of the plan.
10. The plan needs to carefully consider JDSFs role in the regional environment.
11. Mature second growth stands lave been virtually eliminated in Mendocino County, leaving JDSF with some of the most significant stands of mature forest in the area. The public asks that our state forest be managed so older forests are not further extirpated from the region.

12. In all other managed areas, important structural elements, including representatives of the oldest available age classes, wildlife trees, snags, and large down wood, should be maintained across the landscape to mitigate for past and continuing impacts from logging in the region.

RELEVANCE TO PRIVATE LAND MANAGEMENT

13. Demonstrating how to improve young and understocked stands and manage them profitably would be much more relevant to maintaining timber industry viability while addressing the public's interest in maintaining what's left of our older forest stands.

EVEN-AGED MANAGEMENT

14. As a mitigation for the overwhelming regional use of even-aged management and to promote regional forest diversity, please phase out even-aged management on JDSF. Lands that have not recently been managed using even-aged techniques should not be managed using them.
15. Existing even-aged stands should be transitioned to multi-aged or all-aged stands, further reducing the proportion of the forest that is under even-aged management.
16. The need for information (on all forest conditions, including even-aged management) can be accomplished by the state forest system entering into cooperative arrangements with industrial owners (as opposed to conducting even-aged management on JDSF) to conduct demonstration on industrial land where even-aged management is already the rule.
17. Don't need to manage for all seral types. Skew management toward less common seral types as mitigation for industrial management.
18. Should add a map to illustrate harvest history by regime and decade harvested.
19. We question validity of group selection as an uneven-aged management tool. Frequent entries combined with suppression through crowding in the remaining stand raise questions about how beneficial this technique is. Suggest reduction in cut of new areas with this technique while existing blocks are monitored to analyze growth, weed infestation, and regeneration.

RIPARIAN PROTECTION

20. It is almost impossible to understand what is intended regarding riparian protection. Important information is spread across many non-contiguous pages, is contradictory, and is hiding behind the banner of flexibility and is imprecise.
21. There is concern that Class I and II WLPZs add up to 7440 acres, by far the largest area of late seral development in the plan. If they are not as large as indicated, late seral retention and development at JDSF is correspondingly diminished.
22. There is conflict between information on page 70 and in Appendix V on page 152. What is actually proposed for the outer band? Will retention be high basal area, or minimums in Board rules? The figures are meaningless for the public, and for timber managers.
23. Class III streams are recognized by most objective observers as significant sources of sediment into downstream Class I and Class II, and receive no canopy retention standards, but rather a skimpy ELZ.
24. Road construction across inner gorges is allowed after consultation with a geologist. Is this sort of road construction really necessary?

25. The plan is "no take". How does CDF resolve conflict between the proposed riparian protection and NMFS short-term HCP guidelines? The guidelines imply that "no take" would be more protection than "incidental take". They recommend a 180 foot no cut zone for both Class I and Class II streams as well as significant canopy retention for Class III.
26. The CAC made very specific riparian protection recommendations based on a modified FEMAT approach. They are much closer to NMFS guidelines than the more protective version of the JDSF proposal.
27. The plan (pg 87) remarks that limited exemption from certain standards may be sought. Suggest alternative, i.e. How about significantly exceeding standard mitigations? Why not apply NMFS guidelines to a significant segment of the forest, or all of it?
28. Apply specific measures to specific stream classifications. Establish basal area retention standards.

RECREATION PLANNING

29. Overall, recreation planning is deferred to a later date.
30. There are deceptions incorporated into the plan regarding recreation. The person assigned to recreation has no training or experience in recreation, and is simply another forester.
31. The plan leaves the impression that the entries to the principle recreation areas are well marked. They are not. Even a modest effort to inform the public could increase the recreational use of the forest significantly. The plan reflects CDF's lack of enthusiasm for this scenario.
32. Expansion of low impact recreation is a priority for the community, for both recreational participation and as a source of potential economic activity.
33. Figure 5 should more clearly indicate existing trails and proposed trail expansion. The color scheme is illegible regarding trails.
34. There are not enough trails. Designate, map, and construct more trails.
35. Wouldn't it be appropriate to revisit the 1990 and 1997 draft recreation plans mentioned in Appendix VII? The time for investigation is over. Make plans.
36. Provide reasonable no cut zones around major facilities.
37. Integrate access between JDSF, Russian Gulch SP, and Jughandle Reserve. The plan ignores them. Should develop corridors to the ocean through these areas. If Big River Estuary project is funded, should develop a loop trail through JDSF and Woodlands.
38. State parks are often full. Most of the one million visitors have no idea that JDSF exists.
39. Raise priority of recreational planning (pg 106) from normal to high, and enumerate specific steps to provide more facilities and to raise awareness of JDSF.

ROADS

40. Poor control over LTOs building roads is a major issue. Many JDSF roads are quite poor. Should develop specific approach to this problem. Should monitor their performance. Should demonstrate their proficiency. Build penalties into contracts.
41. Should allocate additional finances to road assessment. Complete in two years rather than five.

MONITORING AND ADAPTIVE MANAGEMENT

42. Incorporate actual measures of water quality adaptive management and monitoring, both pre and post operations for all THPs. This should be part of validation monitoring for watercourse related mitigation measures.

EIR ALTERNATIVES

43. Consider additional alternatives, including no logging, logging only to enhance restoration of forest to natural conditions, logging only to enhance restoration with proceeds used to finance the costs of the restoration, including rehab of roads and other landscape features associated with timber operations that are causing negative environmental effects. No action does not mean continuation of activities under the current management plan.
44. Consider a "Environmental and Recreation Enhancement Demonstrations" alternative with demonstrations conducted with goals other than income generation (see letter text for specific recommendations of this alternative).
45. Consider a "CAC Recommendation Implementation" alternative. Apply all CAC recommendations.

MISC.

46. The codes in Appendix VI (pg 149) need to have a key. What is the value expressed in the compartment inventories?
47. What percentage of the forest is being entered in the first five years, expressed as both acreage and volume?
48. Organize the plan so most info on single subject is in same place.
49. Heading on pg 129 is deceiving since board policies adopted as of Feb 21, 2001 not included. What does the date on pg 129 refer to?

DFG, April 13, 2001

Misc. comments:

1. Integrate Chapter 4 into Chapters 2 and 3.
2. Pg 3; the Northern California ESU steelhead were listed August 7, 2000.
3. It is appropriate to have a fixed schedule for review of the plan and potential for changes, in a public forum. The public should be made aware of any plan amendments even if they are deemed to be insignificant.
4. Identify the disciplines that will be used to ensure that projects are planned and evaluated through an interdisciplinary process (pg 3). DFG recommends that this should include plant, wildlife, and fishery biologists.
5. It will be important to back off on impacting activities if budgets associated with enhancement, mitigation, improvement, and/or assessment activities are reduced.
6. DFG supports a new type map. Typing should be at least as detailed as CWHR, and should be capable of being converted to CWHR (pg 15).
7. It is not clear that the current conditions on JDSF are due to "a proportionately greater allocation of the forest resources towards relatively rare vegetation types and wildlife habitats than would otherwise be legally required from surrounding private timberlands" (pg 24). It may be due to JDSF having a better approach to achieving LTSY than its neighbors.
8. By changing the statement "open for public access" on page 25 to "open to the public" may dissuade those who want vehicular access on closed roads, or from making their own roads.
9. What is the "planning period" within which the 2 operations in the Woodlands STA are contemplated?
10. The need for a permanent biologist on staff seems obvious. Is there a plan?
11. Include DFG in any planning and action decisions where the purpose of the special concern area is biological. pg 56
12. The affiliations of the advisory committee members should be provided. pg 91 What interests are represented?

Minor forest products:

13. The permitting process for minor forest products (pg 12) should be reviewed and adjusted based upon CEQA review and input from responsible agencies. This relates primarily to salvage and firewood programs. There should be limitations on maximum diameter size harvested and restricted locations. How is adherence to the permitting enforced, what staffing is being applied to it, what are the consequences for violators, and what are the measures to mitigate violations. Add minor forest products to the list of activities monitored, especially those that are subject to high demand or are slow to recover (e.g., salvage sawlogs, firewood, mushrooms).

Parlin Fork management unit:

14. Was the Parlin Fork Management Unit subjected to CEQA review? Have there been significant changes that warrant revision? A copy of the management plan, or at least a synopsis of its allowances and restrictions should be appended to the management plan to better enable a full assessment of potential impacts (pg 13).

Pygmy forest:

15. The management plan should indicate why Pygmy Forest is declining and define what role JDSF is playing in the decline and what role JDSF can plan in stabilizing and reversing that decline (pg 14).
16. Identify all threats and plans to enhance management of pygmy forest (incl fire). pg 61
17. The plan should promote management to ensure the pygmy forest vegetation type is sustainable. Preventing destructive land uses (eg ORV) should be a goal and research into promoting natural regenerative processes is encouraged. pg 146

Structural habitat elements:

18. The minimum dimension for snags stated on page 16 (11" and 12' tall) are less than desirable in a managed forest. Managing for a minimum may be a risky strategy for wildlife resources. Managing for most vertebrate species is not appropriate, especially in terms of forest habitat elements. Rather, JDSF should provide the appropriate sized habitat elements for all the naturally occurring species. Minimum sizes should start no lower than 24 inches, guided by size and age of dominant tree species that show signs of decline and mortality. A goal of 2 snags per acre greater than 24 inches is desirable. The goal for special wildlife concern areas appears appropriate, but the diameters should reflect the size potential of the dominant trees in those locations. Snags should be distributed randomly in clumps and individually to provide habitat for all the wildlife species that occur in central Mendocino County. Snags should be clumped lower on slopes and individually higher on slopes. The snag goals should be averaged over a standard area to result in diversity of snag density and distribution among different assessment units that assures cavity-nesting opportunities for wildlife. Recruitment of snags is not addressed. Please address snag replacement over time. DFG recommends green wildlife tree retention among the dominants that includes a tree species mix and condition that will result in mortality over time.
19. Goals for size, distribution, and recruitment of LWD should be clearly stated. The goals should reflect the biological conditions of JDSF (species, size, and density). Dead wood elements are very important for wildlife and fisheries habitat. Deviation from standard goals should be considered in the context of experimentation and adaptive management.
20. The retention of structural wildlife elements should be one of the constraints upon even-aged management. Another constraint is to assure recruitment of snags over the life of the rotation through green tree retention. This needs to be a goal of uneven-aged mgt as well (pg 30).
21. How will thinning and partial cutting create or maintain snags? How will direct damage, artificial creation of snags, or retention of dominant green trees of various stages of decline assure future recruitment? Goosepens and chimney trees re very important elements and every effort should be made to protect them during land management activities. These are not being recruited or created.
22. Non-catastrophic mortality should be retain more generally across the forest. Salvage should not occur when stands and areas are deficient in down logs relative to the goals of the plan, and when located more than 100 feet from an existing haul road. pg 42

23. Diameter and size goals for snags should be based upon site potential. Suggest use of a watershed-based criteria as a measurement unit. Goal should be for 3 to 4 snags per acre with no more than 3 of them in the WLPZ (i.e. at least one per acre outside of the WLPZ). pg 62
24. Include quality standards (i.e. soundness) in the LWD standards. Base LWD upon full trees, not portions of broken trees. Distribution should mimic snags. pg 62

Species of concern:

25. The method and resources used to develop the list of species of concern needs to be documented (pg 17,18).The plan should identify all other species of concern in the vicinity of JDSF and indicate why they were not included in Table 1. Indicate in the plan that DFG will be consulted or will participate in the crafting of management strategies for species of concern.
26. Increase quality and quantity of habitat (maintain where there is no other choice). Work with DFG to document the presence of sensitive species and to promote increasing the numbers (through attraction and introduction). Present a list of rare, T and E species that are known or expected on JDSF (pg 29).
27. DFG recommends measures for reintroduction and habitat restoration for species extirpated from the region. pg 43

Northwestern pond turtle:

28. The plan should acknowledge that upland habitat is important for the northwestern pond turtle. Upslope and down slope migration should not be hindered by impassable fences, berms, or other structures. pg 63

NSO:

29. Experimentation on any aspects of NSO response or biology can only proceed under an incidental take permit. pg 64 Include USFWS in habitat protection and species protection section. DFG has not taken any action to endorse survey protocol.
30. Provide basis for parameters under NSO habitat management practices, especially criteria proposed within 1000 feet of activity center. pg 64

Osprey:

31. Will osprey nest trees really be protected "to the maximum extend possible"? That could be a large buffer. DFG suggests buffer be sized to reduce disturbance below level of significance. pg 65
32. DFG suggests that survey visits be less than one month apart. (osprey)
33. The osprey log hauling buffer should apply to new roads and existing roads that have not been used for several years. pg 65

Snag-dependant species:

34. The plan should identify which snag/cavity dependent species are expected to benefit from maintaining or developing forest openings. pg 65
35. Invert the burden of protection for bullet 1 (Vaux swift and purple martin). pg 67 Retain all trees with suitable cavities unless a workable alternative for the impacting land use is not available.
36. Inconsistency between retaining range of species and retaining large DF on pg 68. Range of species is desirable, as are large snags. How will snags be recruited in uneven-aged or groups selection harvests? Other species need snags in areas that might not be identical to those areas used by purple martin. pg 67
37. It is likely that the olive-sided flycatcher and Swainson's thrush will be added to the special concern list. Retention of large diameter trees including snags and dead-top trees, goose pens, and hollow trees will help protect special habitat elements needed by a wide varietyof species including the V. swift, purple martin, olive-sided flycatcher, many bat species, fisher and marten. Avoid and minimize impacts to these critical habitat elements and allow for recruitment of replacement trees once the legacy trees and elements fall from natural causes.

Marbled murrelet:

38. JDSF is recognized as a critical habitat area for the survival and recovery of the marbled murrelet. pg 66 Protection and enhancement of habitat within the forest is vital to assure conservation of the species. (see DFG letter to USFWS, dated June 6, 1994 and Oct 10, 1995). There is a need to identify additional areas for recruitment and enhancement of mm habitat on JDSF beyond existing old growth groves and their buffers. Additional habitat closer to the ocean would be beneficial, given the gradient towards drier climate to eastern portion of JDSF and dependency of mm on ocean environment for foraging. Consider placement and configuration of recreational facilities and use. Some recreation activities are not compatible with protection of mm during nesting. Recreational activities that may be negative include campfire smoke, elevated noise levels, sudden sharp noises associated with campgrounds, picnic areas, and trails. Increase cornid levels are associated with human activities (predation problem). Avoid development of recreational facilities in proximity to mm habitat. DFG recommends predator-proof garbage cans at human use areas and trail heads. DFG suggests visitor education program to reduce occurrence of feeding of corvids. Do this in cooperation with DPR. This includes interpretive displays, educational pamphlets, flyers, and cleanup patrols in campgrounds, picnic areas, and elsewhere. Equestrian use should be subject to limitations to insure weed free hay supplies to help reduce establishment of exotic plants. Maintain equestrian staging areas to assure dung beetle and weed seeds do not artificially supplement corvid diets.
39. The plan does not adequately address the impacts or mitigation for the hazard tree program as it relates to mm nesting and nesting habitat. It is extremely difficult if not impossible to offset habitat losses associated with the hazard tree program. DFG recommends full disclosure of any expansion or reopening of recreational facilities that may be envisioned under this plan. Construction and use of rec. facilities and the hazard tree program put visitor use facilities in direct conflict with mm conservation. The impacts and mitigation measures must be adequately addressed.

40. Consider establishing JDSF as a research area for creation of mm habitat. Investigate silv methods that might accelerate development of nesting platforms. Methods suggested by DFG (see letter).
41. Conventional Pacific Seabird Group survey protocol use makes detection difficult in low use areas. DFG suggests more intensive survey efforts in potential habitat (methods suggested- see letter). This survey would guide establishment of habitat protection/research areas and contribute to revisions of the management plan.
42. The plan does not provide a thorough analysis of the value of old growth reserve/augmentation areas to mm. Such an analysis is difficult, given the lack of occurrence. The mm protection measures are not framed in the context of the local distribution of mm in Recovery Zone 5, or in the long-term context of population persistence. This should be remedied.
43. The Woodlands STA late seral recruitment discussion does not specifically describe or quantify the potential value to mm over time.

Red tree vole:

44. Please reference the definition of potential habitat for red tree voles. pg 68
45. In single tree selection harvests, retain trees with vole nests and fall adjacent trees away. In even-aged areas and within groups in group selection, retain trees with nests and adjacent trees with interlocking branches. Develop a monitoring proposal with DFG to evaluate the effectiveness of measures recommended by DFG.

Misc. species of special concern comments:

46. DFG encourages JDSF to proactively and aggressively manage JDSF to be inhabited by the "Plant and animal species of concern possible present on JDSF". That includes measures to encourage colonization, including working with DFG to establish species of management concern. pg 68
47. There is a need to evaluate the potential of significant impacts to all sensitive species regardless of whether or not they are "listed". Scoping should also identify species that are sensitive, but not yet reduced to rare, T&E. Mitigation measures to maintain local population and habitat should be applied to prevent listing. Notify DFG in a THP and through the NDDB when any species of management concern is detected on JDSF. pg 69
48. DFG recommends that the plan include specific protection, assessment, and monitoring goals for species of special concern. A goal should be to at least confirm the presence of all species of special concern. Confirming presence will help assess silv practices and contribute to revisions of the plan.
49. Special protection needs to be afforded to the interface of old growth and riparian habitats, to protect species that forage over water or use streams as flight corridors (eg mm).
50. Under nest sites for owls and osprey, the acreages should be minima since new findings will mandate more buffers. The plan should acknowledge that other species discoveries might affect the amount of acreage designated "critical areas". pg 146

Bald eagle:

51. Include a program to conduct annual nest-site surveys of known or suspected bald eagle nests under state survey guidelines. DFG recommends development of a territory management plan for protection and management upon discovery.

Peregrin falcon:

52. DFG recommends that the plan contain specific provisions to better assess peregrine use of JDSF through survey. Contact local birders and biologists as a first step. Evidence indicates that peregrines will utilize large redwood trees for nest sites.

Pacific fisher and matrin:

53. The plan should be strongly supportive of reintroduction efforts for the fisher and marten. Restoration and protection of key habitat elements may assist in natural recolonization such that reintroduction may not be necessary. Protection of large diameter trees, large snags, and large diameter LWD will benefit the fisher, martin, and other species. They require a broad distribution of special habitat elements due to their large home range and broad spectrum of prey. How well the preferred alternative for management will meet the habitat requirements of these species should be discussed.

Aquatic habitat:

54. The statement on Page 22 regarding impacts associated with stream clearance activities deserves a citation so that one can understand the severity and the longevity of the relative impacts to channels associated with historic activities (splash damming, yarding in watercourses, elimination of riparian trees, LWD removal).
55. Please cite the sources used to derive the facts and conclusions presented under "Current Condition of Aquatic Resources" on pg 22,23.
56. Approach of "reducing risk" to riparian and stream environments is opposite appropriate approach of "improving habitat conditions". pg 63
57. Class III watercourses should be provided with a WLPZ, or at least a tree retention goal to act as erosion control features and sources of LWD. pg 63
58. DFG suggests that FRAWG can assist in development of the management plan and EIR.
59. DFG interprets the 10 largest tree retention rule to mean on each side of the watercourse. pg 63.
60. Bare areas with connection to the active channel should be treated for erosion, regardless of size.
61. Structures with potential to be damaged by LWD should be high priority for removal or renovation to remove the threat.
62. Road construction and harvesting within the inner gorge should require approval from a fishery biologist as well as a CEG. pg 63 The biologist can provide input on the sensitivity of the in-stream resources.
63. Salvage of LWD under any circumstances should be previewed and subject to conditioning by fishery biologists. pg 63

64. To protect riparian associated songbirds, DFG recommends avoidance of impacts and disturbance in riparian zones during breeding season. Retain riparian understory as a dense and structured vegetation layer.
65. The listing of species that might be affected by riparian management research makes avoidance of impacts a top priority and severely narrows the scope of activities that are researchable. pg 70
66. The stated range of WLPZ widths is confusing. DFG recommends stating the minimums and what conditions would require additional protection. pg 70
67. The numbered items (pg 70) may or may not be appropriate to avoid impacts. The starting point is to benefit listed species, or at worst be neutral.
68. In many cases Class III watercourses merit measures for LWD recruitment to meter sediment downstream and on adjacent slopes. DFG encourages JDSF to adopt an explicit protocol for determining when a WLPZ or some other tree retention standard will be applied to Class III.

Ecological burning:

69. DFG is willing to work with CDF on reintroducing fire as an ecological process in pygmy forest and for fire-proofing late-seral reserves.

Recreation impacts:

70. Several of the recreational activities proposed on page 27 have the potential to impact fish and wildlife resources (e.g. construction of campgrounds, hiking and horseback riding trails). The plan should specify that each activity would require CEQA documentation. Please consult with responsible agencies to develop mitigation measures.
71. The plan should recognize that new recreational facilities or new uses may have impacts upon fish and wildlife resources, and should be cleared through CEQA. Concentrate uses to a limited area to reduce impacts. Don't develop new facilities if they cannot be maintained and receive enforcement of environmental protection rules. Pets should be under the owner's immediate control at all times. pg 76

Monitoring and adaptive management:

72. Work with DFG staff to establish monitoring and assessment programs to assure feedback to the road management program that include costs and benefits to fish and wildlife (pg 30_.
73. It seems unlikely that there can be much adaptive management over a 5 year period, but rather 10 to 20. pg 56

Research and demonstration:

74. An increase in research and demo on JDSF should include increased scientific rigor. DFG and other agencies and specialists should be involved to review and comment upon research and demonstration project proposals. Demonstration needs to consider both long and short-term results (pg 30).
75. How does one access the competitive grant program funds for misc projects outside of the RFP process? pg 91

76. Every harvest should be either a demonstration in itself or be part of a more programmatic demonstration. A timber harvest absent a role in a demonstration should be delayed until the value for demonstration purposes is adopted and described in the THP. pg 95

Hardwood forest and hardwood management:

77. The plan reads as if CDF does not plan to continue to create a market for hardwoods. The section does not include management of hardwood as a dominant tree type. In some sites hardwoods may be naturally dominant. Are there any of these sites? How will JDSF assess whether a site needs to be restored or converted to conifer? The plan should protect true oaks from conversion or restoration attempts (pg 31).
78. The plan should specify goals to assure that the management against hardwoods does not cause significant impacts. pg 57

Exotic species:

79. It is important to document the impacts of pest species and the control efforts upon timber, fish, and wildlife resources. (pg 32)
80. How was the estimate of "very high" determined r.e. risk of new exotics? List the exotics and anticipated actions to control them.
81. Ensure that DFG is invited to participate in planning stages of determining the necessity of introducing natural enemies and planning the project and monitoring the results. pg 58 DFG encourages the use of native herbaceous plants in place of high densities of native conifers to help assure that some of the benefits of disturbance (early successional conditions) are not overly truncated towards a seedling/pole dominated stand. pg 58

Ecosystem management:

82. An ecosystem management approach should limit management actions so that they don't exceed the ecosystem's ability to recover and to provide ecosystem services. The need to harvest timber should not be derived by a volume over time system. pg 41
83. JDSF may not be large enough to examine fragmentation and corridors for a multiple, wide-ranging species. This limitation is more apparent with the use of replicates and controls. Robust results will likely require a long time for many species. There is more to ecosystem management than habitat fragmentation and connectivity.
84. There is more to managing for biological diversity than silvicultural practices and retention areas. This includes investigating the role of other disturbance regimes such as fire or severe storms. pg 42
85. Be more explicit in how the spatial context of a vegetation polygon will be considered when selecting the stand for management. What are some examples of how JDSF will use spatial analysis?

Stand age distribution, spatial allocation plan, and late-seral:

86. DFG questions the even-aged age distribution described at the end of the paragraph (pg 46). It would be useful if it indicated the maximum amount of forest that might be in young, even-aged stands over the 100-year horizon. Are stands up to 150 years of age congruent with the proposed rotation cycles? Does the plan include any of the reserves in the acreage?
87. We are concerned that the proposed 22% late seral forest figure includes WLPZs, due to their narrowness and somewhat compromised habitat value for species associated with late seral forests. There is a high degree of edge for WLPZs adjacent to even-aged management units for the first several decades. Retain the same level of late-seral, but exclusive of WLPZs in even-aged compartments. This may be achievable by managing more of the forest with a goal other than MSP. pg 46.
88. Table6; please present the WLPZ separately from the late seral acres.
89. Add a third goal to the silvicultural allocation plan; safely manage the wildlife resources during timber harvest. The goal strives to mimic natural habitat distribution patterns and disturbance effects and regimes, moving away from activities that differ markedly from natural disturbance patterns and dynamics. Using fire as the dominant historic disturbance regime, this goal might call for realignment of the silvicultural units such that lightest harvest, habitat element goals, reentry cycles, or rotation ages would be the most common low on the slopes. The current allocation would remain, but the boundaries would change. It is time to evaluate how to adjust the scheme to better reflect our (DFG) understanding of wildlife habitat drivers and dynamics. pg 48.
90. The allocation of uneven-aged silvicultural systems leads to allocation adjacent to areas where wildlife habitat values are compromised to some extent by the neighboring uses. pg 50
91. Please clarify the discrepancy between forest practice rule limitations upon "group selection" and the opening size proposed for 14 Gulch. (pg 51)
92. DFG suggests a multi-faceted strategy to avoid CE; a goal for minimal amount of late seral habitat on a landscape and watershed basis, manage non late seral stands to provide some of the values of late seral forests (eg recruitment of elements), let even-aged stands exceed CMAI for a time, and ensure habitat element recruitment in even-aged stands. A reasonable portion of even-aged lands should be allowed to exceed CMAI for several decades to allow them to provide late seral habitat value for some time prior to harvest. Vary rotations by site class, but increase range at older end. This will augment the reserves and serve as a back-up if the reserves are impacted by severe wildfire. pg 52
93. The plan does not justify the 48 inch DBH standard for old growth stands and trees. A detailed discussion of the justification for the standard is needed with appropriate references cited. Consider different standards for different species (eg redwood and D-fir). pg 59 Why was a distinction made between old-growth trees and stands (clearly articulate). Forest management Goal 3 indicates more emphasis on stand characteristics and ecological processes on a scale exceeding individual tree designation. The 2-acre minimum on page 60 also needs discussion and references to justify the standard. The 8-inch branch standard is not discussed or referenced. It is unclear how this branch standard will be assessed or utilized in the field, since it is not a normal inventory category. pg 59

94. The goals for recruitment of late seral forest need to include management for and protection of large snags, large LWD, large branching structure. Define "areas" to be managed for recruitment of old-growth like trees, and identify them with target tree abundance. Beyond specific areas, recruitment of individual trees into old growth-like conditions should be a goal for JDSF which is added to the snag and LWD retention/recruitment goals. pg 60

Plants:

95. Include a monitoring program for plant species of concern that may be subject to impacts. pg 62. Include management for perpetuation, including locally significant populations. DFG recommends guidelines; 1) inventory plants to produce a comprehensive list and identify T&E and locally significant plants. Update regularly and manage to maintain current diversity. 2) special plant populations should be monitored regularly to insure protection against recreation or other forest uses.
96. Relationships and partnerships with local universities and other entities should be developed to encourage scientific research on rare flora.
97. Develop an educational program to inform public about negative effects of picking wildflowers and trampling on vegetation, as well as impacts of invasive/non-native plants on native/sensitive plant populations.

Road management:

98. The road management plan focuses only on the aquatic/sediment connection, although roads are problematic for many terrestrial resources. pg 72
99. DFG trusts that they will be included in the list of "other experts" for road-related measures. pg 73
100. Roads are one of the primary impacting features on the landscape. JDSF should adopt a goal of declining road density. A 10-year moving average could be adopted.
101. DFG encourages helicopter yarding to be very strongly considered as an alternative, especially when dealing with unstable areas. pg 73 This will also reduce the need for new roads.
102. The RMP needs to include closures for other purposes, such as sensitive resources and preventing access to important coho spawining areas, nesting areas of mm if they are documented. Closure enforcement should also be described, (e.g. frequency of gate effectiveness inspections, who and how violations are prevented and cited, etc.) pg 73
103. Road spoil areas to be used to discard slumps during maintenance should be identified. This will prevent the use potential rare species sites without adequate review. pg 73
104. Under what conditions is outsloping not possible or appropriate? pg 75
105. WLPZ roads that are not used should be surfaced. pg 75
106. Under #8, add that crossings are subject to DFG 1600 clearance as well as the mgt plan. pg 75
107. Add to goal #10 a goal to manage for high levels of LWD in all stream classifications. pg 75
108. Under #12, pg 75, DFG recommends treatment of bare soil regardless of area, when in direct contact with the active channel. Treatment to be seed and mulch.
109. Under Operational Implications of Watershed Analysis, watercourses, identify the 1600 permit requirements for drafting (#18). pg 75
110. In what ways do road use agreements constrain JDSF's management options? Do the agreements have clauses that will allow subsequent renegotiation? pg 178

111. Road features such as type of road surfacing and presence of berms , should be identified in road surveys. Old railroad throughcuts should be identified as areas of potential spoils deposition sites.
112. Signage needs should be identified, including periods of closure, warnings of distant closure, and reasons for closure to generate public support. Provide a brochure describing the closure program. pg 180
113. The road inventory should include identification of potential spoils sites, their assessment, and adoption. pg 179
114. Under 1.3, the ability to improve and correct diversion potential should also be identified. pg 181
115. DFG would add provision for a storm patrol during low frequency (high intensity) storms. Setting a goal is not difficult. Aquatic habitats are not the only resources negatively affected by roads. pg 183
116. In the planning stage, avoidance of new roads should be a very high priority. pg 183
117. Under 2.2 (design), bullet 2 should describe "except where unavoidable". Bullet 3 should describe the triggers to "except in very rare cases". Bullet 5 should state that the maximum storm size resulting from the various techniques will be used to size the culvert. Bullet 7 should note that smaller culverts with substantial filll should have armored fill and outflows. pg 184
118. Note that under 2.3, disturbance to bed and banks will require a 1600 agreement. pg 185
119. Under 3, Road Use restriction, Bullet 1 should cite the reference that has proven the practice effective in reducing sediment, Bullet 2 should add the clause "no water is flowing from the road surface", Bullet 6 should prevent blading with a Class III ELZ or within a certain distance of any watercourse or where the road is in-sloped or inside ditched that flows to any watercourse, Bullet 7 should specify closures for any environmental protection reasons, not just road surfaces, also all spur roads and non-use roads should be gated and closed to vehicular traffic, Bullet 10 should specify that screening should protect other aquatic life forms as well as fish, and is water used for dust abatement for non-THP uses. pg 186
120. Under 4.1 (Inspection) for abandoned roads, include effectiveness of the barrier/blockades as one of the potential problems to be evaluated during the inspections and repaired as necessary. pg 186
121. When will the inventory be finished? Within 5 years of when? pg 189
122. The RMP is missing two sections; 1) a monitoring program including invited agencies to participate in assessing the implementation and effectiveness of the plan, and 2) demonstration of the techniques and standards for other landowners and resource professionals.

Forest protection:

123. The Forest Protection section lacks a section devoted to fire management and ecology. This section ignores the fundamentals of the Calif Fire Plan. Implementing the Fire Plan on JDSF could be an outstanding demonstration project. pg 80
124. Pre-suppression is supposed to mean something more now with the Fire Plan. JDSF should use the Fire Plan database to identify and map all assets at risk. The plan should identify natural resources at risk, potential suppression options, appropriate pre-suppression activities. A biologist should be solicited to provide important info to these ends, and a CEQA clearance published. pg 80 Under fire history, data should be overlaid with a fuel

model and vegetation condition data. This moves us towards current and desired future conditions.

125. DFG recommends analytical investigation on potential wildlife effects with shaded fuel breaks. Such a system should have sideboards on the ecology of the forest species possibly affected. pg 80
126. DFG recommends a program to locate natural communities and plant and animal species requiring special protection. Need a program to identify the fire ecology need of JDSF. pg 81
127. JDSF should create a fire ecology brochure and kiosk. pg 81
128. Ecological needs should be addressed in the Suppression plan, or in a unique sub-plan that is attached. pg 81
129. Under Post-suppression, there should be a post-rehabilitation plan section that details appropriate prescriptions for foreseeable fires. Minimally, this would address, how to determine need to seed, how to choose a seed mix, how to determine where to salvage log, how to conduct salvage operations, protection of riparian communities, how to minimize erosion from mechanical activities. A monitoring plan should be developed that evaluates the effectiveness of the rehabilitation. pg 82
130. Under Prescribed fire, fire exclusion is not desirable. JDSF cannot pursue healthy forest conditions if CDF does not provide the resources to implement these objectives. DFG recommends the development of a prescribed fire management plan. DPR can serve as a model. pg 82

Monitoring:

131. Under Timber Resources, DFG recommends elevation of goal 1 to high priority. The goals should explicitly state the presence of decadence as well as CWHR 5 and greater as a parameter. pg 100
132. It appears that snags are not enumerated under IFI parameters. Add species and hardness factors. Another factor that could be added is a vigor factor. CWD should be measured by species and condition as well. pg 100
133. The Adaptive Management Goal #1 should be expanded to include cultivating wildlife structures availability and recruitment in all stands. pg 100
134. Goal 3 should be to manage hardwoods at desired levels, not to selectively remove where overabundant. pg 102
135. Under Watershed Resources, stressing storms needs to be a trigger for monitoring and adaptive management. pg 102.
136. Add information of species of LWD and source to first bullet under Stream Channel Condition. pg 103
137. Extrapolating the Caspar findings to areas with different geology, topography, and forest types even in the Redwood region should be done with care. Developing replicates of this research project would be a valuable undertaking. pg 104

138. Under Wildlife Resources, DFG believes that development of a rigorous inventory of wildlife resources on JDSF would be a prudent exercise. The inventory would include general area species presence for the wildlife community, general area focused surveys for high-profile species, species-specific cooperative studies with adjacent landowners and agencies, and THP specific surveys. This would provide a solid basis for assessing species distributions, habitat needs, and response to habitat alteration, and species trends. pg 105

Letter from Timber Watch (May 31, 2001)

The 1983 plan:

1. There has been no major review of the plan at the five-year mark (1987), not has the plan been completely revised as specified in the plan and the Board policy.

Public notice and participation:

2. No public notice of release of the Plan has been made.
3. The Board should not approve the Plan until the public has had an adequate time to provide informed comment.
4. The BOF should schedule public hearings in Fort Bragg so the BOF can receive input from the local community most affected by the Plan.
5. The EIR should reflect the public comment submitted for the Plan.
6. No operations pursuant to the Plan can take place until its associated EIR is approved.
7. Due to short notice, Timber Watch cannot comment adequately on the Plan.
8. The Plan should be modified to describe what public information resources the management will make available, so the public can make informed comment upon JDSF THPs within the 15 day THP comment period.
9. Prepare a subsequent draft that incorporates public input.

The draft plan:

10. The Plan does not indicate who prepared the plan, or under whose authority. This should be made explicit.
11. The wording in the Plan concerning when subsequent reviews will occur is ambiguous.
12. The plan must have a fixed period, preferably ten years.
13. The BOF should require that the plan have a major review at mid-term.
14. The amendment process should include adequate, timely public notification and provision for public comment with adequate time provided.

No cutting without approved plan:

15. The BOF should curtail all extractive activities on JDSF until the Plan and EIR are approved.
16. While required by law, it is not clear how CDF will insure the public that THPs will conform to the Plan.

Budget and staffing:

17. The budgetary numbers provided in the Plan indicate serious under-funding and under-staffing of JDSF, particularly in the scientific, technical, planning and publication areas. The BOF must see to it that staffing and budget are increased to insure that JDSF has the resources required to carry out its mission.
18. A botonist, planner, writer/designer/publisher, and monitoring staff should be added.
19. Add a full-time staff position to insure that quality, professional publication results are made in a timely fashion, and made available to the public.

Dissemination of research results:

20. The Plan must propose improvements to public dissemination of the results of research and demonstration, but not only in internal CDF publications.

Scientific review panel:

21. JDSF should have a standing independent scientific review panel to help review the Plan and operations conducted pursuant to the plan. Members of the panel should be drawn from outside CDF and include members from academia, environmental organizations, and industry. The panel should help insure that research and demonstration projects are properly designed so that they will produce scientifically meaningful information.

Cumulative impacts:

22. The Plan does not address cumulative impacts sufficiently.
23. The natural resources have not received adequate attention in the Plan.
24. The preliminary draft is insufficient to justify renewed extractive activities.

Letter by Nancy Barth (September 26, 2001)

Forest certification:

1. JDSF should provide an example of sustainable forestry for California, the nation, and the world, and should become certified as "sustainable" as soon as possible.

High quality timber products:

2. JDSF should emphasize production of the highest quality of timber possible and not just sell trees to make money.

Multiple use:

3. The plan must recognize multiple use and address existing and future recreation, non-timber forest products (i.e. mushrooms), improvement of wildlife habitat, and restoration of fisheries.

Recreation:

4. The recreation facilities should remain primitive and subject to very limited improvement and expansions which should utilize volunteer help and donations from local businesses and individuals.

Involvement of local community:

5. JDSF local staff should seek more involvement with the local community through restoration of the twice-a-year newsletter, offering field trips several times a year, presenting programs to local organizations. For example, local neighborhood groups could work with CDF to reduce illegal trash dumping in JDSF.

Letter from Northern California Trails Council, Inc. (August 13, 2001)

Recreation:

1. There should be a management plan that addresses only recreation, taking into consideration the current use and increased popularity of JDSF.
2. Recreation should not be considered secondary. Demand has increased significantly since the 1988 survey. It is hard to realize the new popularity for day use.
3. Regarding the Sherwood Trail, over two years ago, we were advised by JDSF staff that a trailhead would be made usable at the Bean's Orchard site, and that a bridge crossing of the southeast tributary of Russian Gulch would be possible. Nothing has been done on either request. pg 34
4. A defined corridor width of 300 feet around campgrounds is not enough when it involves timber operations. pg 76
5. A boundary line adjustment along Three Chop Ridge is understandable for fire suppression, but not for traffic to and from the San Francisco Boy's and Girl's Camp and Camp Noyo. It would become a dusty speedway. If CDF abandons Road 200, it should only be upstream of the junction with road 250. Trail access should be maintained on any abandoned road. Abandoning Road 200 would exclude visitors from the waterfall. It would make more sense for traffic to the two camps (mentioned above) enter from Sherwood Road and County Road 419A. pg 86
6. Entire group camps should not be reserved. There should always be 3 or 4 camp sites open for the casual overnight camper. We are specifically referring to Horse Camp. Red Tail would be the group camp.
7. THPs should specify a time when logging operations will be completed.
8. Roads through logging areas should remain open on weekends to equestrians, hikers, and cyclists.
9. THPs should require that trailheads and access points for non-motorized users be re-established following completion of logging.
10. Road and trail signs are non-existent in many places. To educate trail users, "Yield to" signs should be posted on all roads and trails.
11. The use of volunteer workers is never mentioned. Volunteers are a valuable resource for clearing trails, maintaining campgrounds, and signing roads and trails.
12. We would like to be part of any recreational planning and to receive notices of public hearings regarding JDSF.

Comments from Advisory Committee Members

Doug Piirto (August 14, 2001)

Misc. comments:

1. It is unclear to what extent non-state forest CDF inspectors are involved in providing compliance oversight. pg 11
2. What management will occur in the Eucalyptus forest in Caspar Creek? pg 14
3. On pg 24, what does proportionately greater allocation of forest resources.....mean?
4. What does the recreational value of 1.2 million dollars mean to managers of JDSF and to local citizens? pg 25
5. Table 3 is important. Is it meant to make the case that JDSF is the only location for R&D on over 3 million acres of forestland in the north coast? What are the units for total inventory (i.e. 2.93)?
6. Endorse forest certification.

Allowable cut:

7. It is unclear how the Parlin Fork Management Unit and other units factor into the annual allowable cut figures. pg 13

Definition of old-growth:

8. How is old-growth defined in the plan? pg 14

Terrestrial habitat:

9. Is it correct to assume that as much as 60% of JDSF is R4D or D4D? Is only 10% either R5D or D5D? Suggest adding clarity to this section, perhaps with a table of WHR on JDSF.
10. What percentage of JDSF is Pygmy? What is the WHR type for Pygmy forest?
11. Snag retention section is difficult to interpret. pg 16 Are IFI plots installed in WLPZ areas? Wouldn't the IFI be most applicable to general forest areas but not so much for WLPZ areas? Is there a need for a separate snag inventory to characterize the density of snags in WLPZ areas?
12. What research or field data support the statement on pg 16 that the current mix of forest seral stages results in a high level of species richness? A WHR table along with an indication of their species richness could be useful as support.
13. What is stated at bottom of pg 16 seems to contradict what is stated in the Species of Concern section on pg 17.
14. Fragmentation and connectivity need further discussion (Chapt 3). How will the manager know when there is too much fragmentation or lack of connectivity as corridors? How is fire history factored into decisions to cut the forest?

Cumulative impacts:

15. How are CI evaluated for each of the 15 planning watersheds?
16. What data management coordination will occur with adjacent owners to allow for cumulative impact evaluation? ref pg 39
17. Will the EIR also cover the road management plan?

Fluvial geomorphology:

18. What is the desired fluvial geomorphology condition as compared to the existing condition?
19. Are there 92 miles of coho habitat, but only 90 miles of fish habitat? Inconsistent.

Fishery:

20. What does it mean, that overall, it is likely that salmonid habitat is near carrying capacity in most years based on out-migration data? How does this relate to the information on current habitat conditions?
21. Is the WLPZ reentry period on a per stand or per stream course basis? How will entry of the WLPZ be avoided if the adjacent stand is entered more frequently than 20 years? pg 63
22. How much LWD will be left in Class I WLPZ? pg 63 What is too little or too much? Does LWD pose a threat to downstream structures and landowners?

Budget:

23. The operating budget to support operations, road maintenance, and timber stand improvement seems very low. How are these budget levels determined?

Silvicultural allocation plan:

24. What criteria were used to designate (differentiate) areas for silvicultural management? pg 48 to 57

Research and demonstration:

25. The listing of R&D needs seems to be a fragmented discussion. Some synthesis of the key ideas is needed.

Ecosystem management:

26. Implementing ecosystem management is not easy. It is imperative that past, existing, and desired future conditions be described using the same set of indicators. It is difficult to actually measure fragmentation against a known past natural range of variability. For sediment, what is the threshold of concern? These are difficult issues?

Letter by Dave McNamara (August 15, 2001)

Planning:

1. How do you define significant revisions? pg 4

Misc. comments:

2. What the 1999 measurement of the 1/5 acre plots in the CFI or only the IFI? pg 10
3. The statement "provide a proportionately large amount of public benefit....." on page 15 is a poor one. The value should be on wildlife and fish habitat, with the public secondary.
4. Gulch 14 should be in even-aged management since opening size exceeds 2.5 acres. pg 51
5. The ELZ restrictions on pgs 63 and 70 do not agree.

Snags:

6. How will snags be recruited? Who set the guideline of 3 snags per acre and their sizes? pg 16

Allowable cut:

7. Were special concern areas removed from estimate of allowable cut? eg WLPZ pg 48

Letter by Gary Nakamura (August 29, 2001)

Strategic research and demonstration goals:

1. In keeping with the state forest's demonstration and research goals, to what extent should timber harvests and other activities by consistent with, advance the development of, the forest's strategic research and demonstration goals? A strategic research goal for determining cumulative effects?
2. The connection of the 5-year timber harvest plan to research and demonstration goals is not clear.
3. The overarching demonstration at JDSF is "what does sustainable production of forest products in the coast redwood forest type look like? What are the effects on wildlife habitat, watersheds, soils, and other resources? What are the economics of the silviculture and management practices conducted to implement that sustainable production?
4. To what extent do the existing even-aged management areas on the forest satisfy the demonstration needs for that system? Should future timber harvests only use uneven-aged systems?
5. How are research projects decided upon at JDSF?
6. Is there a state-wide plan for demonstration and research on state forest? What are we trying to demonstrate, to whom, where, and what do we expect to result? Developing this plan should include researchers, communities of interest, and others whom we expect to believe the results of the research, to participate in, or to benefit from the demonstrations.
7. There is a great need for social science research in forestry. JDSF is an opportunity to research and demonstrate how citizens, the public, interest groups can and should be involved in the management of our public forests.

Sustainability:

8. In what sense is the current relationship between budget and profits sustainable, assuming that timber harvest does not equal habitat/watershed destruction?

Alternatives:

9. What forest resource values would be enhanced or augmented by a decrease in the annual harvest or a change in the silvicultural system?
10. In what way does the goal of funding FRIF, producing income in excess of operating costs, distort the decisions made regarding level of harvest and manner of harvest? (the "profit incentive=bad management" issue)

Advisory committee:

11. JDSF warrants another technical advisory committee with greater research expertise than the SFAC has.
12. We need to inform the public about forest management, and learn how to listen to them and respond to their interests and concerns. Does JDSF have a citizens advisory committee for a Friends of Jackson State Forest? Such groups would improve public understanding of the state forests and could provide structured input to forest plans and management activities.

Appendix 7
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APPENDIX 8A
DESCRIPTION AND REVIEW OF INVENTORY, GROWTH AND YIELD

A. Description and Review of Inventory Growth and Yield

B. Detailed Analysis of EIR Project Alternatives to Proposed Action

C. Aquatic Resources

D-1. Species Descriptions for Rare, Threatened, Endangered, and Sensitive Plants

D-2. Guidelines for Assessing the Effects of Proposed Projects on Rare, Threatened, and Endangered Plants and Natural Communities

D-3. California Native Plant Society's Inventory of Rare and Endangered Plants of California Selected CNPS Plants by Scientific Name: JDSF--Project and Adjacent, Rationale For Inclusion of Species For Consideration On JDSF Ownership

D-4. Potential Resources For Species Accounts

E. Wildlife: Sensitive Species

F. Wildlife: List of CWHR Mammals, Birds, Reptiles and Amphibians and Associated Habitats Type That Are Either Known or have the Potential To Occur on or in the Vicinity of JDSF

I. DESCRIPTION AND REVIEW OF INVENTORY, GROWTH AND YIELD

VEGETATION TYPING

The JDSF Vegetation Classification System vegetation type maps used in this analysis are derived from remotely sensed Landsat satellite imagery. A consulting firm under contract to JDSF completed the vegetation typing in the fall of 1996. The vegetation map was used as the basis for the timber inventory update completed in 1997. The vegetation map was created using a combination of field plot summaries, aerial photography, and field verification. Training sites consisted of accurately located forest inventory plots. The coverage was developed using an unsupervised classification process with input from local field staff. The procedures used to create the vegetation map are as follows:

Register and Terrain Correct Images--Two Landsat Thematic Mapper (TM) images were acquired, one from 10 July 1989, and the other from 11 June 1996. These images were both geographically registered using control points derived from easily identifiable features in JDSF's GIS data such as road intersections, rock outcrops, and confluence of streams. The imagery was terrain corrected using a 10-meter digital elevation model created from elevation contours that were derived from USGS 7.5 minute topographic maps. The Root Mean Squared (RMS) error of the registration and terrain correction process was 1.2 pixels (or 36 meters ground distance). The RMS error of the registration between images was 0.2 pixels (or 6 meters ground distance).

Determine Areas of Significant Vegetation Change--One of the sources of information used to create the vegetation map was a summary of vegetation characteristics from existing field plots (established in 1989). To avoid using plot summaries from areas that had experienced significant change, a "vegetation change map" was produced using digital change analysis techniques that examined the difference in vegetation indices between the 1989 TM image and the 1996 TM image. Areas that exhibited substantial increases or decreases in vegetation were identified, and field plots from those areas were excluded from use in the determination of vegetation characteristics.

Conduct Unsupervised Classification--An unsupervised classification of the 1996 TM image was produced for the East and West sides of the forest. The unsupervised image classification (ISODATA), which classifies image pixels into statistically distinct classes, was done independently for the east and west portions of the forest. Twenty-five unique classes were identified in each portion of the forest. The unsupervised classification provided important information on the heterogeneity of the forest, and served as a guide for identification of "training sites" for later stages of preparation of the vegetation map.

Select Training Sites--Based on field investigation, summaries of field plot vegetation characteristics, and 1:12,000 color stereo aerial photography (1993 and 1996 photo dates), representative areas for each vegetation type found in JDSF were identified. Training sites were delineated on the aerial photos. Training sites were first selected for areas that were most homogeneous (based on the unsupervised classification). Areas of increasing heterogeneity required increasing field verification and refinement to identify training sites. A minimum of two training sites was identified for each vegetation type. Field plots from 1989 were updated for growth to represent 1996 conditions.

Conduct Supervised Classification--Based on the identified training sites, the 1996 TM image was classified using a maximum likelihood classifier. The classification was done in a stepwise progression, with the most spectrally unique and easily identifiable vegetation types classified first. Those areas that were classified in the early steps of the process were "masked out" so as to limit the number of classes and variability within the image to be classified. A composite classified image was produced that merged each step of the classification. Six or seven reflectance bands, or ratios and transformations of the TM reflectance bands, were used to reliably separate vegetation classes within each classification step.

Conduct Field Verification--Maps of the vegetation classification were produced and taken to the field for verification. Field review was conducted to verify the correctness and consistency of each vegetation type. Two rounds of field verification and subsequent modification of the vegetation typing were conducted.

Aggregate Vegetation Strata--The final vegetation classification of was aggregated into several levels of aggregation: 1, 2, 5, and 10 acre minimum polygon size. Upon review, it was decided that a 5-acre minimum polygon size would be used, except in areas designated as Group Selection, where a 2.5-acre minimum polygon size would be used. The aggregation into vegetation polygons was done using a "majority filter."

Vegetation Classification Systems

A subset of the JDSF Vegetation Classification System was created by the Forest that resulted in a new combination of vegetation types, size classes and densities to describe Vegetation Management polygons. This was essentially a crosswalk procedure that reclassified the polygons created using the procedure described above. The following tables present the crosswalk from JDSF vegetation type to the Vegetation Management types.

TABLE VI-5.3F
JDSF VEGETATION CROSSWALK TO VEGETATION MANAGEMENT

JDSF Vegetation Types	Vegetation Management
Redwood	Redwood/Douglas-fir
Redwood/Douglas-Fir	Redwood/Douglas-fir
Douglas-Fir/Redwood	Douglas-fir/Redwood
Mixed Conifer	Douglas-fir/Redwood
Hardwood/Redwood	Mixed Hardwood/Conifer
Alder	Mixed Hardwood/Conifer
Closed-Cone Pine/Cypress	Pine
Pygmy Forest	Pygmy
Mixed Hardwood/Conifer	Mixed Hardwood/Conifer
Grass/Bare Ground	Non Timber
Brush	Non Timber

TABLE VI-5.3G JDSF SIZE CLASS CROSSWALK TO VEGETATION MANAGEMENT SIZE CLASS		
JDSF Size Class	**DBH Range**	**Vegetation Management**
1	<1"	<18”
2	1"-6"	<18”
2O	Size 2 (>75%) under 4, 5 or 6	<18”
3	6"-11"	<18”
4	11"-18"	<18”
4M	Size 4 over 2 or 3	<18”
5	18"-24"	18”+
5M	Size 5 over 2, 3 or 4	18”+
6	>24"	18”+
6M	Size 6 over 2, 3, 4 or 5	18”+

TABLE VI-5.3H JDSF DENSITY CROSSWALK TO VEGETATION MANAGEMENT DENSITY		
JDSF Density	**Percent Cover**	**Vegetation Management Density**
S	10-24.9	S
P	25-39.9	S
M	40-59.9	M
D	60-79.9	D
E	80-100	D

California Wildlife Habitat Relationship (CWHR)

The vegetation types described according to the JDSF vegetation classification system can also be described according to CDFG's California Wildlife Habitat Relationships system of habitat classification (Mayer and Laudenslayer, 1988). The JDSF vegetation classification system is based largely on the CWHR system, but includes more specific categories to describe species composition, tree size, and canopy density. Since the two systems are similar, a crosswalk to convert the JDSF system to the CWHR system was developed for the analysis in the wildlife section. The conversion of JDSF vegetation types to CWHR types allows for the use of California Department of Fish and Game’s CWHR database to assess available habitat for affected wildlife populations. Tables VI-5.3I, J, and K demonstrate the crosswalk steps to convert JDSF types to CWHR types.

TABLE VI-5.3I JDSF VEGETATION TYPES CROSSWALK TO CWHR TYPES	
JDSF Vegetation types	**CWHR types**
R-Redwood	RDW-Redwood
RD-Redwood/Douglas-Fir	RDW
DR-Douglas-Fir/Redwood	RDW
MC-Mixed Conifer	RDW
HR-Hardwood/Redwood	RDW
AL-Alder	RDW
CPC-Closed-Cone Pine/Cypress (Bishop Pine/Cypress)	CPC-Closed-cone Pine Cypress
Pygmy-Pygmy Forest	CPC
HC-Mixed Hardwood/Conifer	MHC-Montane Hardwood Conifer
GRBG-Grass/Bare Ground	AGS-Annual Grass
BR-Brush	MCH-Montane Chaparral

TABLE VI-5.3J JDSF SIZE CLASS CROSSWALK TO CWHR SIZE CLASS		
JDSF Size Class	**DBH Range**	**WHR Size Class**
1	<1"	1
2	1"-6"	2
2O	Size 2 (>75%) under 4, 5 or 6	2
3	6"-11"	3
4	11"-18"	4
4M	Size 4 over 2 or 3	4
5	18"-24"	4
5M	Size 5 over 2, 3 or 4	4
6	>24"	5
6M	Size 6 over 2, 3, 4 or 5	5

TABLE VI-5.3K JDSF DENSITY CROSSWALK TO CWHR CANOPY CLOSURE		
JDSF Density	**Percent Cover**	**WHR Canopy Closure**
S	10-24.9	S
P	25-39.9	P
M	40-59.9	M
D	60-79.9	D
E	80-100	D

The CWHR system also includes a multi-layered tree class identified as a type 6. CWHR type 6 is defined as:

- a stand with a distinct layer of size class 5 trees over a distinct layer of size class 3 and/or 4 trees, and
- a total tree canopy closure of the layers ≥60%, and
- the layers must have ≥10% canopy cover and distinctive height separation.

The JDSF vegetation system does not have a direct way to crosswalk to CWHR type 6, however a combination of the JDSF size class and density can be used to provide a reasonable estimation of CWHR type 6. Stands with JDSF size class **6M** and a density of **D or E** would crosswalk to CWHR type 6.

This crosswalk is likely to overestimate the area occupied by type 6 stands for several reasons:

- The JDSF classification of size class 6M includes trees greater than 24 inches over trees from 1 to 24 inches, while the CWHR type 6 is limited to trees greater than 24 inches over trees from 6 to 24 inches.
- The JDSF system is based solely on diameter distribution that may or may not represent canopy layers, while the CWHR type 6 requires distinct canopy layers as well as diameter distribution.
- The JDSF system does not specify canopy cover density or distinct height separation, while the CWHR type 6 requires that the layers must have ≥10% canopy cover and distinctive height separation.

Refer to the Wildlife sections for the results of the crosswalk and a discussion of the results.

Botanical Series

The Botanical setting and analysis sections present and discuss the major vegetation communities based on the series and associations developed by Sawyer and Keeler-Wolf (1995) and Holland (1986). CDFG and the California Native Plant Society recognize and accept the vegetation series used as the desired method for describing plant communities. For comparison, Table VI-5.3L presents a crosswalk of JDSF vegetation, CWHR types and the botanical vegetation series.

TABLE VI-5.3L
CROSSWALK OF JDSF VEGETATION, CWHR TYPES, AND THE BOTANICAL VEGETATION SERIES

JDSF Vegetation Types	CWHR Types	Botanical Series
Redwood	Redwood	Redwood
Redwood/Douglas-Fir	Redwood	Redwood
Douglas-Fir/Redwood	Redwood	Redwood
Mixed Conifer	Redwood	Redwood
Hardwood/Redwood	Redwood	Redwood
Alder	Redwood	Redwood
Closed-Cone Pine/Cypress	Closed-cone Pine Cypress	Bishop pine

TABLE VI-5.3L CROSSWALK OF JDSF VEGETATION, CWHR TYPES, AND THE BOTANICAL VEGETATION SERIES		
JDSF Vegetation Types	**CWHR Types**	**Botanical Series**
Pygmy Forest	Closed-cone Pine Cypress	Pygmy
Mixed Hardwood/Conifer	Montane Hardwood Conifer	Redwood
Grass/Bare Ground	Annual Grass	N/A
Brush	Montane Chaparral	Redwood

Timber Inventory

Intensive Forest Inventory (IFI): Estimates of timber volumes and other vegetation characteristics are derived primarily from a system of plots referred to as the JDSF Intensive Forest Inventory (IFI). This system of plots was established in 1989. The IFI is based on a stratified random sampling design. The IFI plots were located on randomly selected points of a 10-chain grid. The plots were installed as 3-plot clusters or single plots, with each plot being comprised of 3 nested fixed radius plots. Trees 11 inches and greater were measured on the largest plot ($1/5^{th}$ acre). Trees 7 inches to 10.9 inches were measured on the intermediate plot ($1/20^{th}$ acre). Trees 6.9 inches and smaller were tallied by 2-inch classes on a $1/100^{th}$ acre regeneration plot. Tree measurements included species, diameter breast height and live crown ratio. A subset of trees was also measured for total height, defect, and 10-year radial increment.

As discussed above, a new vegetation strata map was produced for this project in 1996. Some of the existing plots were located in areas that were harvested some time between 1989 and 1996, and therefore no longer represented the new conditions. These plots were removed from the inventory system. In addition, some of the 1989 IFI plots could not be reliably located relative to the new vegetation strata map, and were also removed from the inventory system. This resulted in a number of vegetation strata being under-represented from the perspective of growth and yield modeling or reliable timber volume estimates.

To fix this problem, an additional 130 clusters (390 plots) were installed in early 1997. These supplementary sample plots conformed to the same design as the IFI plots installed in 1989. The 390 supplementary plots from 1997 along with the 1,506 surviving 1989 plots provided sufficient data to compute volume and to project growth and yield estimates. The 1,506 unharvested 1989 plots were updated to account for growth from 1989–1997 using the FREIGHTS growth and yield simulator.

The Forest was divided into two inventory blocks, separated along the western edge of Chamberlain Creek planning watershed to account for significant differences in stocking between the west end and the east end of the Forest. The east inventory block consists of the eastern WWAA and a relatively small area in the headwaters of Two Log Creek in the eastern portion of the southern WWAA. The west inventory block consists of the northern WWAA, the western WWAA, and most of the southern WWAA.

Continuous Forest Inventory: The original continuous forest inventory (CFI) system consisted of 141 rectangular one-half acre permanent plots distributed on a square 3/4-mile systematic grid across the forest (sixty chains between plot centers). The plots were first established and the first measurements were obtained in 1959. Since then, the plots have been re-measured in 1964, 1969, 1974, 1984, 1989, and 1999.

The original one-half acre CFI plots were fixed area rectangular plots, 2 chains by 2.5 chains. In addition to the main plot there were three subplots: a one-quarter acre subplot was put in at the time of the first measurement to measure tree heights in order to establish a height-diameter relationship. This subplot was only put in during the first measurement of the plots in 1959. Subsequent re-measurements did not measure heights, but rather relied on this relationship to estimate heights. A 1/25-acre subplot was used to measure trees 3.0 inches to 10.9 inches DBH. Finally, 40 one thousand acre subplots were used to record conifer reproduction less than 3.0 inches DBH.

General data measured at each CFI plot includes aspect, slope, age class (young growth/old growth), and whether the stand has been harvested in the past. Data measured on individual trees include species, DBH to the nearest 1/10-inch, merchantability class, crown class, vigor class, defect indicators, and regeneration status of the tree (re-measured, ingrowth, logged). Heights were measured on approximately half of the trees at the time of the first measurement in 1959. These data were used to estimate a height–diameter relationship that was used on subsequent re-measurements.

This original inventory design was used for five re-measurement occasions, in 1959, 1964, 1969, 1974, and 1984. The design changed in 1989, when a new plot system was established, consisting of 308 permanent plots and 2,054 temporary plots. Starting in 1989, permanent plots were circular one-fifth acre plots rather than rectangular one-half acre plots. Of the 308 permanent plots, 140 were located at the plot centers of the original CFI plots. The remaining 168 permanent plots were established using the stratified random sample design of the 1989 inventory.

The 1989 permanent plots consisted of a one-fifth acre (52.7 feet radius) main plot on which all trees greater than 11.0 inches DBH were measured. All trees 7.0 inches DBH and larger were recorded on a one-twentieth acre subplot. Finally all trees 1/10 of an inch or greater DBH were measured on a one-hundredth acre subplot.

Summary of Vegetation and Inventory

Table VI-5.3M is a summary of the 1997 IFI inventory. Information is presented for the east and west side of the Forest. The JDSF Vegetation classification system, The CWHR system and the Vegetation Management classification system are included in the table for comparison. This table includes a JDSF vegetation type identified as GSEL that was used to classify timber stands recently harvested under the group selection silviculture method. Due to the complex structural mosaic created by group selection areas, this type was kept as a separate category.

TABLE VI-5.3M
TIMBER INVENTORY VOLUMES AND VEGETATION TYPES ON THE EAST AND WEST ENDS OF JDSF

	JDSF Vegetation Type	WHR Types	Vegetation Management	Site Class	Acres	Conifer Volume (mbf/ac)	Hardwood Vol (mbf/ac)	All Species Vol (mbf/ac)	Conifer Total (mbf)	Hardwoods Total (mbf)	All Species Total (mbf)
E	BR	MCH	NON-TIMBER	3	22.96	10	6	16	229.6	138	367
E	BR	MCH	NON-TIMBER	4	7.08	9	5	14	63.72	35	99
E	BR	MCH	NON-TIMBER	8	33.1	8	5	13	264.8	166	430
E	DR5DM	RDW4D	DR18+D	2	479.03	26	2	28	12,454.78	958	13413
E	DR5DM	RDW4D	DR18+D	3	777.71	25	2	27	19,442.75	1555	20998
E	DR5DM	RDW4D	DR18+D	4	364.77	23	2	25	8,389.71	730	9119
E	DR5EM	RDW4D	DR18+D	2	191.64	28	2	30	5,365.92	383	5749
E	DR5EM	RDW4D	DR18+D	3	169.56	27	1	28	4,578.12	170	4748
E	DR5EM	RDW4D	DR18+D	4	216.01	27	1	28	5,832.27	216	6048
E	DR5PM	RDW4P	DR18+S	3	288.04	8	3	11	2,304.32	864	3168
E	DR5PM	RDW4P	DR18+S	4	545.05	8	2	10	4,360.4	1090	5450
E	DR6DM	RDW6D	DR18+D	3	54.48	47	6	53	2,560.56	327	2887
E	DR6DM	RDW6D	DR18+D	4	85.6	46	6	52	3,937.6	514	4451
E	GRBG	AGS	NON-TIMBER	2	32.95	0	0	0	0	0	0
E	GRBG	AGS	NON-TIMBER	3	26.88	0	0	0	0	0	0
E	GRBG	AGS	NON-TIMBER	4	5.3	0	0	0	0	0	0
E	HC3E	MHC3D	HC<18D	2	123.67	14	6	20	1,731.38	742	2473
E	HC3E	MHC3D	HC<18D	3	1,056.93	14	5	19	14,797.02	5285	20082
E	HC3E	MHC3D	HC<18D	4	523.74	14	5	19	7,332.36	2619	9951
E	HR3E	RDW3D	MC<18D	2	269.91	10	3	13	2,699.1	810	3509
E	HR3E	RDW3D	MC<18D	3	1,186.86	9	3	12	10,681.74	3561	14242
E	HR3E	RDW3D	MC<18D	4	1,447.74	9	3	12	13,029.66	4343	17373
E	MC5DM	RDW4D	DR18+D	2	4.91	19	5	24	93.29	25	118
E	MC5DM	RDW4D	DR18+D	3	49.33	19	5	24	937.27	247	1184
E	MC5DM	RDW4D	DR18+D	4	31.71	19	5	24	602.49	159	761
E	R5MM	RDW4M	RD18+M	2	13.76	6	3	9	82.56	41	124
E	R5MM	RDW4M	RD18+M	3	92.97	6	3	9	557.82	279	837
E	R5MM	RDW4M	RD18+M	4	68.49	6	3	9	410.94	205	616
E	R6DM	RDW6D	RD18+D	2	164.35	33	3	36	5423.55	493	5917

TABLE VI-5.3M
TIMBER INVENTORY VOLUMES AND VEGETATION TYPES ON THE EAST AND WEST ENDS OF JDSF

	JDSF Vegetation Type	WHR Types	Vegetation Management	Site Class	Acres	Conifer Volume (mbf/ac)	Hardwood Vol (mbf/ac)	All Species Vol (mbf/ac)	Conifer Total (mbf)	Hardwoods Total (mbf)	All Species Total (mbf)
E	R6DM	RDW6D	RD18+D	3	398.78	32	3	35	12,760.96	1196	13957
E	R6DM	RDW6D	RD18+D	4	169.44	32	3	35	5,422.08	508	5930
E	R6MM	RDW5M	RD18+D	2	6.84	26	2	28	177.84	14	192
E	R6MM	RDW5M	RD18+D	3	93.81	25	2	27	2,345.25	188	2533
E	R6MM	RDW5M	RD18+D	4	252.91	25	2	27	6,322.75	506	6829
E	RD2M	RDW2M	RD<18M	3	8.57	27	0	27	231.39	0	231
E	RD5PM	RDW4P	RD18+S	2	106.11	17	3	20	1,803.87	318	2122
E	RD5PM	RDW4P	RD18+S	3	159.21	16	3	19	2,547.36	478	3025
E	RD5PM	RDW4P	RD18+S	4	43.43	16	3	19	694.88	130	825
E	RD6E	RDW5D	RD18+D	2	45.6	42	2	44	1,915.2	91	2006
E	RD6E	RDW5D	RD18+D	3	104.82	42	2	44	4,402.44	210	4612
E	RD6E	RDW5D	RD18+D	4	24.68	42	2	44	1,036.56	49	1086
E	RD6EM	RDW6D	RD18+D	2	41.98	23	4	27	965.54	168	1133
E	RD6EM	RDW6D	RD18+D	3	743.48	23	4	27	17,100.04	2974	20074
E	RD6EM	RDW6D	RD18+D	4	720.8	22	3	25	15,857.6	2162	18020
E	RD6MM	RDW5M	RD18+M	2	173.75	15	4	19	2,606.25	695	3301
E	RD6MM	RDW5M	RD18+M	3	474	14	4	18	6636	1896	8532
E	RD6MM	RDW5M	RD18+M	4	664.95	13	3	16	8,644.35	1995	10639
E	RD6PM	RDW5P	RD18+P	2	429.63	24	3	27	10,311.12	1289	11600
E	RD6PM	RDW5P	RD18+P	3	1443.78	23	2	25	33,206.94	2888	36094
E	RD6PM	RDW5P	RD18+P	4	1161.45	23	2	25	26,713.35	2323	29036
W	AL	RDW	HC	2	13.07	20	6	26	261.4	78	340
W	AL	RDW	HC	3	6.66	19	6	25	126.54	40	166
W	AL	RDW	HC	8	37.64	19	6	25	715.16	226	941
W	CPC5E	CPC4D	PINE18+D	3	359.12	36	0	36	12,928.32	0	12928
W	CPC5E	CPC4D	PINE18+D	8	262.96	34	0	34	8,940.64	0	8941
W	DR5DM	RDW4D	DR18+D	2	2164.94	61	2	63	132,061.3	4330	136391
W	DR5DM	RDW4D	DR18+D	3	926.52	59	2	61	54,664.68	1853	56518
W	DR5DM	RDW4D	DR18+D	4	343.63	56	2	58	19,243.28	687	19931
W	DR5EM	RDW4D	DR18+D	2	673.97	46	1	47	31,002.62	674	31677

TABLE VI-5.3M
TIMBER INVENTORY VOLUMES AND VEGETATION TYPES ON THE EAST AND WEST ENDS OF JDSF

	JDSF Vegetation Type	WHR Types	Vegetation Management	Site Class	Acres	Conifer Volume (mbf/ac)	Hardwood Vol (mbf/ac)	All Species Vol (mbf/ac)	Conifer Total (mbf)	Hardwoods Total (mbf)	All Species Total (mbf)
W	DR5EM	RDW4D	DR18+D	3	104.69	44	0	44	4,606.36	0	4606
W	DR5EM	RDW4D	DR18+D	4	75.99	42	0	42	3,191.58	0	3192
W	GRBG	AGS	NON-TIMBER	2	93.69	0	0	0	0	0	0
W	GRBG	AGS	NON-TIMBER	3	38.46	0	0	0	0	0	0
W	GRBG	AGS	NON-TIMBER	8	17.21	0	0	0	0	0	0
W	GSEL	GSEL	GSEL	1	7.98	65	0	65	518.7	0	519
W	GSEL	GSEL	GSEL	2	1,285.99	62	0	62	79,731.38	0	79731
W	GSEL	GSEL	GSEL	3	75.53	60	0	60	4,531.8	0	4532
W	HC3E	MHC3D	HC<18D	2	95.97	39	5	44	3,742.83	480	4223
W	HC3E	MHC3D	HC<18D	3	59.76	39	5	44	2,330.64	299	2629
W	HC3E	MHC3D	HC<18D	4	17.05	38	5	43	647.9	85	733
W	HR3E	RDW3D	MC<18D	2	461.23	42	6	48	19,371.66	2767	22139
W	HR3E	RDW3D	MC<18D	3	124.22	40	6	46	4,968.8	745	5714
W	HR3E	RDW3D	MC<18D	4	324.65	39	5	44	1,2661.35	1623	14285
W	MC5DM	RDW4D	DR18+D	2	37.45	50	0	50	1,872.5	0	1873
W	MC5DM	RDW4D	DR18+D	3	113.97	48	0	48	5,470.56	0	5471
W	PYGMY	CPC	PYGMY	8	612.67	1	0	1	612.67	0	613
W	R6DM	RDW6D	RD18+D	1	25.08	66	2	68	1,655.28	50	1705
W	R6DM	RDW6D	RD18+D	2	2,055.62	64	2	66	131,559.7	4111	135671
W	R6DM	RDW6D	RD18+D	3	1,023.77	62	2	64	63,473.74	2048	65521
W	R6DM	RDW6D	RD18+D	4	79.07	60	1	61	4,744.2	79	4823
W	R6MM	RDW5M	RD18+M	1	22.62	69	3	72	1,560.78	68	1629
W	R6MM	RDW5M	RD18+M	2	2,362.49	66	2	68	155,924.3	4725	160649
W	R6MM	RDW5M	RD18+M	3	478.44	64	2	66	30,620.16	957	31577
W	R6MM	RDW5M	RD18+M	4	137.65	62	2	64	8,534.3	275	8810
W	RD1	RDW1	RD<18	2	94.15	0	0	0	0	0	0
W	RD1	RDW1	RD<18	3	16.35	0	0	0	0	0	0
W	RD2EO	RDW2D	RD<18D	2	26.76	27	1	28	722.52	27	749
W	RD2EO	RDW2D	RD<18D	3	33.83	27	1	28	913.41	34	947
W	RD2M	RDW2M	RD<18M	2	1,523.82	17	0	17	25,904.94	0	25905

TABLE VI-5.3M
TIMBER INVENTORY VOLUMES AND VEGETATION TYPES ON THE EAST AND WEST ENDS OF JDSF

	JDSF Vegetation Type	WHR Types	Vegetation Management	Site Class	Acres	Conifer Volume (mbf/ac)	Hardwood Vol (mbf/ac)	All Species Vol (mbf/ac)	Conifer Total (mbf)	Hardwoods Total (mbf)	All Species Total (mbf)
W	RD2M	RDW2M	RD<18M	3	99.57	17	0	17	1,692.69	0	1693
W	RD3P	RDW3P	RD<18S	2	598.21	5	0	5	2,991.05	0	2991
W	RD3P	RDW3P	RD<18S	3	4.65	5	0	5	23.25	0	23
W	RD5PM	RDW4P	RD18+S	2	1,462.15	49	2	51	71,645.35	2924	74570
W	RD5PM	RDW4P	RD18+S	3	139.44	47	1	48	6,553.68	139	6693
W	RD6DM	RDW6D	RD18+D	2	28.34	86	0	86	2,437.24	0	2437
W	RD6DM	RDW6D	RD18+D	3	76.05	85	0	85	6,464.25	0	6464
W	RD6DM	RDW6D	RD18+D	4	22	84	0	84	1,848	0	1848
W	RD6E	RDW5D	RD18+D	2	296.38	49	0	49	14,522.62	0	14523
W	RD6E	RDW5D	RD18+D	3	126.16	48	0	48	6,055.68	0	6056
W	RD6E	RDW5D	RD18+D	4	15.53	47	0	47	729.91	0	730
W	RD6EM	RDW6D	RD18+D	2	2,420.24	70	1	71	169,416.8	2420	171837
W	RD6EM	RDW6D	RD18+D	3	1,131.56	68	1	69	76,946.08	1132	78078
W	RD6EM	RDW6D	RD18+D	4	39.93	66	1	67	2,635.38	40	2675
W	RD6MM	RDW5M	RD18+M	2	800.36	33	2	35	26,411.88	1601	28013
W	RD6MM	RDW5M	RD18+M	3	223.8	32	2	34	7161.6	448	7609
W	RD6MM	RDW5M	RD18+M	4	231.42	31	2	33	7,174.02	463	7637
W	RD6PM	RDW5P	RD18+S	1	119.6	55	1	56	6,578	120	6698
W	RD6PM	RDW5P	RD18+S	2	6,449.97	53	1	54	341,848.4	6450	348298
W	RD6PM	RDW5P	RD18+S	3	2,397.05	51	1	52	122,249.6	2397	124647
W	RD6PM	RDW5P	RD18+S	4	152.37	50	1	51	7,618.5	152	7771
					48,652				2,002,685	90577.72	2093263.22

Forest Growth and Yield

The Draft Forest Management Plan relies on growth and yield projections completed by CDF and presented in the Option "A" document submitted with Timber Harvesting Plans. The following procedures were used. Forest growth projections are based on the 1997 timber inventory that is grown and harvested over time. Projections are completed for land type polygons that based on vegetation strata and management considerations. The resulting growth projection represents the expected future conditions that will result from applying one silvicultural prescription to a particular land type over time. The set of all possible growth trajectories for all silvicultural prescriptions for each land type becomes the pool of candidate prescriptions. The forest-planning model assigns one prescription from this pool to each land type, thus creating a management alternative for the Forest. 17,101 different growth projections were created in the growth projection stage of the analysis.

In order to analyze the effects of successive generations of stands on the same site, it is necessary to project forest development out for a sufficiently long time to capture conditions likely to result from a given management direction applied consistently over time. The projection period used analysis was 120 years.

The growth, harvest, and yield models have been integrated into a single computer simulator that makes it feasible to examine large numbers of complex management scenarios. This simulator is referred to as FREIGHTS (Forest Resource Inventory, Growth, and Harvest Tracking System). Dr. Bruce Krumland of Landring, Inc developed the CATS model used within FREIGHTS to project timber growth and yield for the JDSF's stands. This model is similar to the CRYPTOS computer model developed earlier by Krumland and Wensel.

FREIGHTS grows each inventory plot individually from the start of one growth period to the beginning of the next successive growth period. Individual plot simulation results are then merged into an average stand condition. A growth period of one decade was used. Growth and yield information is normally reported for the "average" condition of each period, normally the mid-point of that period, just after any harvests or plantings. Some yields are reported for the beginning of the period. All plots are then aggregated to arrive at periodic stand statistics. This procedure avoids the risk of bias associated with plot aggregation. All harvests and regeneration are assumed to take place at the midpoints of projection periods.

CDF found that initial growth simulations with the FREIGHTS model with default calibration coefficients resulted in over estimation of growth when long-term projections under conservative silvicultural prescriptions with few harvest entries were modeled. This assessment was made based on JDSF foresters' local experience and published yield tables (Lindquist and Palley 1963). The FREIGHTS growth model was calibrated to a lower growth rate using a stand density index (SDI) approach (Stage 1983). It was based on the observation that when stand density approached a given percentage of maximum stand density as defined by Reineke (1933), mortality will occur, thereby reducing stand density and growth rate. Inducing mortality at 80 percent of the maximum stand density index produced long-term growth trajectories that corresponded to local evidence and the reviewed literature.

The SDI and maximum SDI were calculated for each land type for each growth period based on basal area weighted by species (Daniel, Helms and Baker 1979). If the SDI exceeded 80 percent of the maximum SDI, mortality was simulated as thinning from below in the smallest crown ratios until SDI of the stand was 80 percent of the maximum SDI.

The resulting growth trajectories proved to closely match observed growth rates on the Forest under the proposed management as well as evidence in the reviewed literature (Lindquist and Palley 1963).

As part of the analysis for this project, Jim Lindquest and Jerry Allen completed an independent review of the growth and yield information. Their findings have been incorporated into the impacts analysis section of the Timber Section and the complete text is attached here.

II. JACKSON DEMONSTRATION STATE FOREST:

Some comments on growth and yield estimation

Gerald M. Allen
Department of Forestry
Humboldt State University
April 5, 2002

Reliable forest growth and yield data are essential for good forest management planning, and the Jackson Demonstration State Forest (JDSF) is no exception to this tenet. During the development of the 2001 Draft Forest Management Plan the JDSF personnel utilized modern, best available techniques to insure the growth and yield estimates utilized in the planning process were as comprehensive and accurate as possible.

The forest vegetation at the JDSF is primarily a mix of second growth redwood and other conifers. This type is common throughout the redwood range and dominates industrial and non-industrial private lands. In the early 1960's it became apparent that the second growth redwood resource was going to become economically important and information quantifying its growth and yield was lacking. To fill this knowledge gap, empirical yield tables and growth equations were developed by scientists at the University of California, Berkeley (Lindquist and Palley, 1963 and 1967). These models were for unmanaged, naturally regenerated stands and were utilized as the standard for second growth redwood growth and yield estimation for many years. As the second growth redwood industry developed, information on growth and yield of managed stands was required and the Redwood Yield Cooperative was formed. The ultimate product of this cooperative was the publication of the Cooperative Redwood Yield Project Timber Output Simulator or CRYPTOS in 1982 (Wensel, Krumland and Meerscharert, 1982). This simulator is an individual tree – distance independent model that projects stand growth under a variety of management scenarios. Data used to construct CRYPTOS came from an extensive collection of permanent growth plots located in Del Norte, Humboldt, and Mendocino counties. Most stands were from 15 to 90 years breast height age and ranged from 50 to 450 trees per acre. About 70% of the sample plots were from apparently even-aged stands with the remainder being from two-storied or multi-aged conditions (Wensel, Krumland and Meercharert, 1982). A complete discussion of CRYPTOS can be found in Krumland (1982).

CRYPTOS was the primary tool used to construct growth and yield estimates for the 2001 JDSF Management Plan. Before the model was implemented it was "calibrated" to reflect similar yields as those found in the empirical yield tables (Lindquist and Palley, 1963). This calibration was required because the tree mortality functions in CRYPTOS tend to be too conservative over long-term projection periods, resulting in over estimation of stand growth. Other models with similar architecture have recognized this shortcoming and additional mortality has been added through the use of a maximum stand density index (SDI) approach (Hester, Hann and Larsen, 1989; Wykoff, Crookston and Stage, 1982). At JSDF a maximum SDI was determined for each land type and projection period, and thinning from below (smallest diameter trees first) was performed to maintain the stands at 80% of maximum SDI. This procedure, although not precisely correct, is an appropriate methodology and should result in conservative stand projections.

JDSF has had a continuous forest inventory (CFI) plot system since 1959. This system consists of permanently located plots where the same trees are re-measured at specified time intervals. In 1989 the CFI system was re-designed and additional plots established. Currently there are 141 such plots on JDSF; they were inventoried in 1989 and 1999. The CFI system is very important to growth and yield determination in that they give a "reality check" to any model estimations. Although CFI information cannot predict what future growth will be under new management practices, it can, unambiguously, quantify what growth has occurred under past management practices.

Growth and Yield Estimates Under the Proposed Alternatives

Alternative A (No direct management activity)
This alternative describes the effects of minimal maintenance and protection of JDSF with no harvest of timber. The demonstration value of this alternative is limited to forest development with no human activity, an unlikely scenario for any but a very small amount of acreage in the redwood region.

The ability to maintain the health and vigor of JDSF would be limited under this alternative. Stocking control, the manipulation of stand density, is THE major tool available to forest managers for stand improvement, forest health maintenance and control of growth. Without the ability to control stocking through timber harvests, stands on JDSF will develop slowly thus lengthening the time late seral stage stand structures can be attained. The growth potential of the forest will be significantly reduced since stands will remain in "overstocked" conditions for long periods. Finally, forest health issues may become apparent as stands develop in crowded conditions.

Alternative B (Management remains consistent with 1984 Management Plan)
Alternative B describes JDSF maintaining the current level of forest demonstration, timber production, recreation development, and environmental protection consistent with the 1984 management Plan. It includes an annual timber harvest of about 29 million board feet and conservative harvesting practices that meet or exceed the requirements of the California Forest Practice Rules. Given that this alternative is the continuation of past practices, a good estimation of the growth that will occur is the growth that has occurred, particularly for short (10 to 20 year) time horizons. Results from the 1989 to 1999 CFI measurements indicate that the forest is currently growing at an annual rate of 65 million board feet, or approximately 1,300 board feet per acre per year. Unless significant forestland is allocated to uses other than timber production the 29 million board feet harvest should be easily sustained.

Alternative C (Long-term sustained yield with enhanced wildlife and fishery habitat)
Alternative C describes maximization of long-term sustained yield with enhanced wildlife and fishery habitat. This alternative proposes an annual timber production at a level consistent with the productive capacity of the forest, and describes a timber management program based on determining and working towards a long-term desired future habitat, watershed, and growing stock condition. Annual harvests would average 31 to 33 million board feet for the planning horizon.

Growth and yield estimates for this alternative must rely heavily on model predictions since proposed timber management activities differ from past actions. CRYPTOS, calibrated to the empirical yield tables and constrained to 80% of maximum SDI, was used for these predictions. It is unclear what SDI value constituted the "maximum" for each land type but it is implied that it was determined from inventory information. The literature (Reinike, 1933; Allen, et. al. 1996; Lindquist and Palley, 1963) indicates that the maximum SDI for second growth redwood stands is about 1000 (1000 trees per acre at a mean stand diameter of 10 inches). On high sites, this maximum is reached the stand has developed for about 100 years; stands on lower sites would reach this maximum much later (Lindquist and Palley,

1963). Consequently, it is very doubtful that any of the stands on JDSF have SDI values close to 1000. Utilizing a smaller maximum would constrain the growth projections to be lower than might be expected in real stands.

CRYPTOS was constructed using data from stands less than 90 years old, however, projections for this study were made for 120 years. Given that some of the stands on JDSF are currently 100 years old, these projections are significantly past stand ages included in the original database.
CRYPTOS is not inherently an age-based model but relies on the growth of trees to generate stand growth predictions. Age does play a role in tree growth estimation in that height growth is generated from site index curves (Krumland, 1982). Since height growth curves tend to "flatten out" (become asymptotic to some maximum value) at older ages, extrapolation to older ages can be made with some degree of confidence.

Most of the data used to construct CRYPTOS came from even-aged stands (Wensel, et. al., 1982) so the ability of the model to adequately represent uneven-aged or all-aged stand growth must be considered. CRYPTOS has the ability to enter and grow ingrowth (regeneration initiated by some disturbance activity) trees at any point in a simulation; these trees are then projected forward in the tree list along with the original trees. To empirically investigate the accuracy of redwood ingrowth projections following a harvest, a CRYPTOS simulation was performed where a stand of 300 redwood trees per acre at age 20 on site index 110 land was grown for 30 years, 150 square feet of basal area (out of a total of 350 square feet) was then harvested and 30 ingrowth trees were entered. The ingrowth trees ranged from 1 to 2.5 inches in diameter and from 10 to 15 feet in height. The model was then run for another 25 years to evaluate how the ingrowth trees behaved thus giving an indication of how regeneration is treated by the model. After 25 years, trees that started as 10 to 15 feet in height were estimated to be 55 to 65 feet tall, even though they were growing under a fairly closed canopy. Work by Barrett (1988) found that height growth of redwood regeneration growing under even a partial canopy slows to almost zero relatively soon after establishment. Thus, indications are that CRYPTOS over estimates the performance of regeneration under partial cutting strategies. This may have significant impacts on long-term growth projections under uneven-age management schemes.

This alternative emphasizes long-term sustained yield and proposes about 45% of the silvicultural systems be uneven-aged. An additional 23% of the forest will be managed for a high density of large trees and late seral characteristics through application of uneven-aged silviculture. Given the ability of CRYPTOS to accurately predict regeneration development under these systems is questionable, JDSF must be diligent in its monitoring of these stands. There is little doubt that growth of the over-story in the uneven-aged stands will be adequate to ensure sustainability in the short term but the development of the understory regeneration may not meet the anticipated levels as estimated by CRYPTOS.

Alternative D (Citizens advisory committee)
This alternative focuses on the conversion of the entire forest to an all-aged structure. There would be no harvest of old-growth trees and even-age regeneration methods would not be used. Annual removals would total about 20 million board feet per year all of which would come from singletree selection harvests. Growing stock would increase from the current 45,000 board feet per acre to over 100, 000 board feet per acre in decade 12.

Growth and yield projections for this alternative are not critical since the harvest level is well below current growth levels. Even if growth projections were high by a factor of three the cut levels could be maintained. As previously noted CRYPTOS was calibrated to generate very conservative growth estimates. Again, a cautionary note should be raised about the validity of regeneration growth rates under all-aged cutting systems, particularly singletree selection.

Alternative E (Late seral emphasis)
This alternative emphasizes the development of late seral forest across the landscape. There would be not even-aged management or harvest of old-growth trees and timber harvesting would be designed to advance timber stand development to late seral characteristics. Annual harvest levels would be around 10 million board feet per year via individual tree selection systems. Growing stock levels would increase each decade to an average of over 80,000 board feet per acre in decade 12. All revenues generated would be spent for maintenance and improvement of JDSF. Like Alternative E the harvest levels are so low that even with substantial errors in growth estimation they can be easily sustained.

III. SOME COMMENTS ON THE EFFECTS OF SILVICULTURAL OPTIONS ON FOREST STRUCTURE

James L. Lindquest
April 2, 2002

INTRODUCTION

Four studies conducted in recent years on the JDSF provide the basis for these comments on the alternatives presented in the draft JDSF EIR. These comments will be directed primarily to the proposed action (Alternative C in the DEIR) consisting of the Draft JDSF Forest Management Plan. The JDSF management plan proposes that three silvicultural systems be installed to demonstrate whether these systems are appropriate to meet the requirements for timber production and protection of other values on the stands assigned to the three major categories of silvicultural management.

Caspar Creek Cutting Trials (CCCT): Experience with installing an uneven-aged system on the stands of the JDSF has been going on since the Caspar Creek Cutting Trials (CCCT) were established in 1959-62. These trials set out five separate blocks that included two tests of single tree selection (33 acres), group selection (21 acres), a clearcut (14 acres), and an uncut (5 acres). Sample areas were laid out in each block after the desired cutting was done. All trees >11.0 inches DBH in the sample areas were tagged at measurement of diameter and height. All tagged trees were subsequently measured six times between 1960 and 1984. These records provide the basis for the report published in 1988 concerning the CCCT results up to 1984. Shortly after the CCCT was installed the JDSF partially logged the entire drainage of the Caspar Creek South Fork to study its hydrology. The original stand of the CCCT was 85 years old at logging and for trees > 11.0 in. DBH there were 140 trees with 378 sq ft of basal area and 111M bd ft. per acre.

The second study of the CCCT blocks was a pre-commercial thinning of the 19-year stand in the 14-acre clear cut block This study started in 1981 put in five treatment levels leaving 100, 150, 200, 250, and 300 trees/acre and an uncut control plot in each of three blocks. Results of thinning and subsequent measurements in 1986, and 1998 after 26 years of growth have been reported. Volume and height growth of trees after a regeneration cut are the main items of interest to this current discussion.

Whiskey Springs: A commercial thinning of a well stocked 41-year old redwood stand near Whiskey Springs in 1970 provides some measure of the stand growth and regeneration growth 30 years after partial logging. The 12 plots in this study averaging 400 sq ft of basal area were then thinned from below leaving three plots of 100, 200, and 300 sq ft, and three uncut control plots. In 1971 the stumps in all plots were mapped and the sprout regeneration was tallied and measured. Regeneration was measured and thinned in 1986 leaving 20, 30, 40 stems in each .1 acre subplot. Results of the sprouts diameter and height growth under 25%R and 50%R canopies are of primary interest.

Hare Creek regeneration study: The final study of interest is the Hare Creek regeneration study following clear cutting in two blocks and a partial cut in the third. This study was installed in 1993 using six random plots per block. The original inventory mapped trees and stumps, and number of sprouts tallied and heights measured. A second inventory in 1993 tallied the number and size of the established sprouts. This second inventory also sampled with 4-milacre plots the conifer seedlings and brush conditions that developed after logging.

UNEVEN AGED SILVICULTURE

The true test of the uneven-aged stand management in a tree selection silvicultural system put into stands with a developed structure will depend how the stand regeneration responds to the first entry. The heart of this system is that after each cutting a fresh set of regeneration is established. The CCCT initial use of the tree selection system in 1960 set up two levels of residual stands, the second entry into the two stands was made in 1987.

The overstory reduction of trees >11.0 inches DBH in the light selection left 52% of the original 139 trees, the heavy selection left 38%of 130 trees. Board foot volumes were reduced in the light selection to 63M from 105M, and to 53M from 111M in the heavy selection. These volume values of the residual stands represent 57% and 48% of the uncut control volume of 110M. Despite this reduction in stocking, the periodic annual growth (PAG) rates for 24 years between the 1960 and the 1984, (light=1388 heavy=1461 yr/ac/yr) remained at over >70% of the PAG in the uncut control (1895/ac/yr). The tracks of stand volumes over this first 24 after cutting remain nearly parallel with that of the control. It is evident that the logging did not seriously affect volume production. The nature of the selection left the best vigorous trees whose volume growth as percent of the initial stand volume did better than the control.

The second entry into these block was made in 1987, the JDSF Fairbank Sale. The original plan for the light select was for three more cuts; each cut to remove 20% of the stems of the second growth stand. For the heavy select there were to be two more cuts to remove the second growth. Prior to the 1987 logging the staff of JDSF re-measured the tagged trees in the plots. After the logging the plots were inventoried in 1990 for the condition of the residual overstory and regeneration. The logging in the light selection removed 46 of the 85 trees >10.5 in. DBH and volume reduced from 95.6M to 26.9M bd ft. The heavy select took 49 of the 70 trees >10.5 in. DBH, and the volume reduced to 6.5M of the 89M prior to logging. The stand table for the heavy select blocks shows only 48.5 trees/acre and basal area of 35.3 sq ft. for trees>4.5 in. DBH. There is very little growing stock available for the next entry. The light selection stand is somewhat better stocked, but it only has 59 trees >4.5 in. DBH and 59.0 sq ft of basal area/acre. Whether either block will be capable of recover to ensure a commercially viable cut at the next scheduled entry is in doubt.

Response of the stands to the partial logging, as it affects regeneration, is not positive at the end of the first 24 years of growth. The initial regeneration inventory, a year after logging, done by the JDSF staff is shown in Table 1. The redwood sprout numbers in that survey only reported the number of sprout clumps, not a total count of the number of sprouts in the clumps. Redwood seedlings in the selection blocks average about 1100 /acre. Douglas-fir seedlings average 1226 in light selection and 674 in the heavy selection. The number whitewood, grand fir and hemlock, exceed the number of redwood and Douglas-fir by about 2000 seedlings/acre in each of the selection blocks. At one year there appeared to be a great potential to restock the cut blocks. The

1984 inventory was done only in the five plots in each block using a milacre sample for stems <4.5 feet tall and a 4-milacre for trees>4.5 feet. Stocking of redwood and Douglas-fir has dropped to only 180 stems/ acre of these two species while there were nearly 1600 whitewood in the light selection. The heavy selection had 330 redwood and Douglas-fir and 1080 whitewood >4.5 feet. Neither of the two desired species has survived nor gown in useful manner. The sprouts in particular are not vigorous nor as numerous under the light conditions despite a sufficient number of redwood stumps in the plots. The light conditions are not capable of supporting adequate diameter and height growth of redwood and Douglas-fir despite over removal of more than 50% of the trees and basal area of the overstory. Grand fir and hemlock made up about 95% of the regeneration in the light selection and 72% in the heavy. The most vigorous and tallest stems >4.5 feet were grand fir.

Following the 1987 logging a re-inventory of the surviving regeneration was made in 1990. The system of sampling was the same as that done in 1984. The three years between logging and inventory allowed some sprouts on new redwood stumps and fresh mineral soil for seedling establishment. Since these block were heavily logged the better light conditions have allowed redwood and Douglas-fir numbers to improve. Equally important to the conditions is that the logging took a heavy toll on the grand fir and hemlock populations in both treatment blocks. Overall Douglas-fir has not responded well to the logging. The 85-year old second-growth stand that was about 40% Douglas-fir in 1960. After the 1987 logging Douglas-fir in the 1990 regeneration is about 10% of the stems >4.5 feet in the light selection and 0% in the heavy selection blocks. Both treatment blocks show improved numbers of both redwood and Douglas-fir in <4.5' segment of the treatment blocks.

GROUP SELECTION

The JDSF management plan considers that group selection blocks <2.5 acres are to considered an uneven aged silvicultural system. This appears to offer a workable compromise; it allows regeneration to be established under light conditions that are suitable to both redwood and Douglas-fir. Stand volume growth in the uncut portion of this block is like the stand prior to the logging; the cut portion did not grow volume. The values in the study of the group selection reflect the random positioning of the plots. Some of the plots had areas that were logged plots were not entered in 1960. The average number of trees >11.0 in. DBH dropped from 141to 109 in 1960, and volume from 98M to 80.0M in the five plots after logging. During the 27 years until the re-logging the average stand rose from 109 to 130 trees/acre and the board foot volume 80M to 126.3M, a PAG of 1713 yr./ac/yr. This growth rate is 90.4% of the uncut block, clearly the group harvest did not seriously affect stand volume growth rate. The 1987 logging reduced the >10.5 in DBH stand to 71 trees and 61.7M bd ft. per acre.

Regeneration results in the CCCT group selection plots created in 1960 shows that both redwood and Douglas-fir populations had improved between the 1960 and 1984 inventories, and whitewoods declined during the period, Table 1. Many redwood sprouts in the openings had grown past the 4.5" DBH limit and were tallied into the overstory in 1984. These redwood and Douglas-fir are the majority of the new stems in 1990; grand fir is not the principle species as in the selection cuts. The uncut portions of the groups had virtually no regeneration. Survival of the 1969-84 regeneration in the group plots was not impacted by the logging, as was the case of the selection reentry.

WHISKEY SPRINGS STUDY

This commercial thinning study was started in 1970. A 41-year old stand of redwood was commercially thinned to 25%R, 50%R, and 75%R of the original 400 sq ft /ac. This study is included in the discussion of the uneven-aged silvicultural system since the stand's treatment and the resulting regeneration can be considered an analog of selection tree removal. The regeneration that was established after the thinning has grown under three levels of residual overstory ranging from a light to a heavy cutting. The initial stocking inventory, a year after logging, showed heavy sprouting under all three overstories, from 2000 /acre in the 75%R to >8000/acre in the 25%R plots. Re-inventory in 1986 the showed the number of established sprouts >4.5 ft. tall were: 25%R=1720, 50%R=960, 75%R=270 per acre. After the 1986 inventory the regeneration was thinned leaving .1 acre subplots of 100,200,300 stems per acre in each of the 25%R and 50%R main plots. Sprout growth in the 75%R plots so slow that that the average sprout diameter was .5 inches and height 6.9 feet. The 75%R plots were dropped from consideration of further study of regeneration response to the overstory.

Three inventories of the 25%R and 50%R plots in 1986,1991 and 1999 of diameters and heights of dominant or co-dominants in the understory are shown in Table 2. In 1999 when this regeneration was 29-years old only one tree in the 25%R plots was >10.5 inches, the threshold for board foots calculations. The 25%R overstory had only 45 trees per acre but the canopy has closed and the understory dominant stems are slowing in growth. Periodic annual average height growth (PAG) dropped from 1.9 ft./yr. (1986-91) to .82/ft/yr. (1991-99). For the 50%R plots the comparable rates were .4 ft./yr. to .5 ft/yr.

In the 50%R plots only two trees are >4.5 inches in diameter at 29 years. Essentially at 29 years the understory is contributing little volume to the 50%R plots and just started to show board-foot volume in the 25%R plots.

Overstory volume growth for the 29 years since thinning these plots closely resembles that in the tree selection plots of the CCCT in that the reduction of the stand by thinning to 25,50, and 75 percent of the stand did not seriously affect the volume response of the residual stand. The 25%R (45 trees/ac.) has periodic annual growth (PAG) of 1803 bd ft, this 71% of that of the uncut plots, 2521 bd ft. Volume PAG of the 50%R plots (117 tree/ac.) has nearly the same volume PAG 2541 bd ft. as for the uncut plots, 2541 bd ft. The volume growth 75%R plots (205 trees/ac.) PAG of 3002 bd ft was 119 % of the uncut plots. Despite significant differences in the residual stands after thinning there are not significant differences in volume growth between treatments.

EVEN AGED SILVICULTURE

The first example of even age management was in the clear cut block of the CCCT study. This block, cut in 1962, had an 18 plot pre-commercial thinning study installed in 1981 when the regeneration was 19 years old. The stand prior to thinning 136 sq ft of basal area and averaged 742 trees/ac which were >1.5 in. DBH. For trees>10.5 in. DBH the plots averaged 45.7 sq ft. and 40 trees/ac. Thinning left the levels of 100, 150, 200, 250, 300 trees/ac, and uncut control in three plots for each treatment. These plots were measured after thinning in 1981, and again in 1986 and 1998. The T100, T200, and uncut plots all averaged 1759 bd ft. the PAG for the 17-year period. The best PAG was in T250 at 2600 bd ft, next was T150 at 2423 bd ft. followed by

T300 at 2053 bd ft. Clearly the thinning did not reduce the capacity of the residual stands to produce volume at rates equal or better to the uncut plots. The enhanced radial growth of the thinned stands more than made up the loss of stems. Periodic average diameter growth ranged from 7.4 inches in T100 and T150 to a low of 2.9 inches in the uncut plots. Average site index of 174 in these plots ranged from 166 to 186, based on site index at 100 years.

An important factor in this current discussion of silvicultural system's effect on stand regeneration is that of diameter and height growth of this even-aged cohort of redwood sprouts. Average dominant height at thinning in 1981 was 54 ft. this increased to 67 ft. in 1986 and 96 ft. by 1998. The diameter and heights of the dominant redwood are compared to those in at Whiskey Springs in Table 2. Ages of measurement in the two studies are not exactly the same but near enough to give a measure difference believed to be the result of differences in overstory. Average heights in this CCCT study at 24 years are 19 ft. taller than trees at Whiskey Springs 25%R at 29 years. During the 12-year period, 1986-98, at Caspar Creek the dominant redwood grew 2.48 ft/yr., at Whiskey Springs in the 8-year, 1991-99, the periodic annual height growth was .82 ft/yr.

The Hare Creek sprout study, the second example of clear cutting and partial logging, was established in 1984. Three cut blocks clear cut and burned, clear cut unburned, and a partial logging were selected for study of sprout regeneration. Locations and size of stumps and trees in six plots per block recorded and mapped and number and size of sprouts measured. No information about the existing brush or other conifer regeneration was taken. A re-inventory of the 18 plots done in 1994 counted the established sprouts at each stump location and measured diameter and height of the tallest sprout. A sample of the conifer and brush regeneration was made using four random 4-milacre plots. Each conifer and brush stem's location, height (7 ht. classes), and crown diameter were recorded. The results of this study conform that of the other studies, i.e., good height and diameter growth in clear cuts with marginal growth results under a dense overstory. A brief summary of the results and differences between treatments is shown in Table 3. The heavy sprout regeneration in the clear cut blocks is more than adequate to restock the stand; however, there is enough Douglas-fir to stock openings between sprout clumps. The clear cut and burned sprouts are a year younger than the other blocks; the original sprouts were burned. This burning also resulted in a 2500 stems/ac. of blue blossom and manzanita >7 ft tall, this seriously affected the Douglas-fir seedling growth.

PROPOSED ALTERNATIVES AND EFFECTS ON SILVICULTURAL SYSTEMS

These comments on the proposed alternatives are made in light of the above discussion and mandates and objectives set out in the legislation that established the JDSF. The 2001 draft management plan also expands the areas of stand management and demonstration that need to be addressed. There are also factors of stand structure and age classes that have arisen over the past 60 years that affect the jobs of future stand management.

Alternative A. This alternative to only watch and not actively deal with the problems of forest economics, recreation, wildlife, water, soil, and a host of other impacts on the forest system is in conflict with the intent of the original legislation. The idea of long-term sustained yield to assist the local and regional economic health is also not addressed under this alternative.

Alternative B. This alternative, to continue the management of JSDF as outlined in the 1973 plan, would continue to place emphasis on timber production by mainly using even-aged management. The draft 2001 plan redirects management to put a greater emphasis on the demonstration aspect of the JDSF mandate. The need to demonstrate the uneven-aged silvicultural system was not given the impetus of a designed program. The Helm's study in Railroad Gulch and the CCCT provide some information about stand growth and regeneration after the first entry into these older second growth stands. The long-term plan requires a period of 60 to 80 years to determine the effectiveness and efficiency of this silvicultural system to produce volume and the required regeneration. However, once a study is in place monitoring may indicate if adaptations need to be made to reach the desired goal.

Alternative C. This alternative is that described in the section of the draft as " desired future conditions". Broader based investigations of several types of silviculture are defined; these are tailored to meet the needs of different client audiences. The assignment of specific acreage to three major systems described and their resulting growth rates may cause the proposed annual cut to be severely impacted. Results of growth and yield of second-growth stands give evidence that single-aged stands produce mean annual increment (MAI) of >1000 yr/ac/yr by age 50 in site 160 stands and by 30 years in site 180. Significantly improved MAI rates are possible in stands pre-commercially thinned (PCT), to establish a structure of well-spaced vigorous stems. These single-aged stands are to be used only in 2000 acres reserved for research in the 2001 proposal for stand management. The reserve-form and storied-cuts, described in the draft require leaving 5 to 30 stems/acre, should be cut in a manner that avoids crown closure before the regeneration has time to dominate the space. The canopy of the 25%R plots at Whiskey Springs, 45 trees/acre had nearly closed in 15 years. Diameter and height growth of the understory was severely retarded. Under these conditions of crown closure at 29 years only one tree of the 270 trees measured was >10.5 in. DBH. Height growth of the dominant redwood understory grew at a rate of .8 ft. per year in the last 8-year period. Under these conditions rotation ages may be extended beyond the 120 years proposed in the draft management plan. Reduced yield and longer rotations may be expected if too many tall heavy and deeply crowned residual trees be left in place after logging.

The single tree or tree cluster selection in the acres assigned to the uneven-aged system will require extreme care in marking and logging over a long period of time to arrive at a balanced uneven-aged stand structure. The retarding of understory growth and the development of light conditions more favorable to shade tolerant grand fir and hemlock can result in a stand of regeneration that is not prepared for recruitment of redwood and Douglas-fir into the board-foot inventory. Repeated entries into the stands may cause logging damage that could reduce the overstory growing stock to levels that cannot maintain a desired growth level. Management of the growing stock will require careful analysis of the stand diameter and age structure and to insure proper marking of the harvests to maintain the progress toward the desired balanced stand. The second growth can produce satisfactory growth across a wide range of basal area stocking levels as shown by the CCCT and Whiskey Springs studies. However if the initial sequence of entries are heavy enough to produce acceptable understory growth the overstory may be reduced to a sub-standard level of volume growth. This may also result in a long period of time before replacement trees are capable of sustaining volume growth required to meet the desired level of annual cut. In the Whiskey Springs understory thinning and the CCCT heavily thinned precommercial plots there has been virtually no suitable sprouts established on the new stumps.

The understory itself has created more severe conditions for any new sprouting. Much of the success of this system of silviculture will depend on the ability of understory trees to develop vigorous crowns and release when given the space they require.

Acreage designated for group selection should provide the most satisfactory means of meeting the desired harvest levels, and also providing an acceptable way of establishing vigorous growing stands of redwood and Douglas-fir. These group cuts of 2.5 acres should be able to establish a cohort of trees that will compete for space as equals and grow crop trees at a rate consistent with the site quality.

Alternative D. The recommendations of the Citizens Advisory Committee would remove all silvicultural study except for single tree selection. This does not meet the mandate of the JDSF to provide an economic basis for the property and the region, and to address the problems of large timber operations. The concerns regarding potential impacts of the selection system on forest growth and development discussed in Alternative C would apply to this alternative also. This option in effect creates a park-like environment where silvicultural for a commercial operation is not a factor.

Alternative E. Application of this alternative to the entire JDSF, even more severely than alternative D, limits the use of the land for research of the broad spectrum of activity as established by the original legislation. Redwood has an ability to respond to a wide variety of conditions and the late seral seems to require little silvicultural activity consistent with silvicultural management of forest stands. The concerns regarding potential impacts of the selection system on forest growth and development discussed in Alternative C would apply to this alternative also.

SUMMARY

These are the three main problems that have directed my comments.

1. The impact of crown closure on the growth of understory regeneration is a major concern in all of the silvicultural systems. Only the group selection does not have some level of overstory being in place after harvest.
2. Leaving an overstory of a level of density that favors grand fir and hemlock and slows redwood and Douglas-fir growth.
3. Allocation of over 33,000 of 45,500 acres to uneven-age management and still expect an increase in the annual growth levels. Until enough time has elapsed to see how the uneven-aged stands regenerate and grow after three or more entries the allocation plan should be more cautious.

IV. EVALUATION OF LATE SUCCESSIONAL FOREST DEVELOPMENT FOR ALTERNATIVES B, C, D AND E AS PRESENTED IN THE DEIR FOR THE JDSF FOREST MANAGEMENT PLAN

Dale A. Thornburgh, Ph.D.
Department of Forestry
Humboldt State University
March 30, 2002

Note: This evaluation was completed by Dale Thornburgh at the request of NRM Corporation to provide a basis for comparison of alternatives in regards to late seral/successional forest development. The evaluation is limited to alternatives that propose active management of the timber stands. Alternative A was not considered in this evaluation. This evaluation is also limited to the use of unevenaged silvicultural in the various alternatives. Although the evenaged silviculture presented in the Draft Management Plan includes retention of forest structure to provide wildlife habitat, and includes relatively long rotation ages in some management compartments, it is the intent of this system to produce a stand of trees that will be harvested at a certain age. The evenaged management areas are essentially outside of the range of consideration for development of late successional forest characteristics.

ALTERNATIVE B

1984 Management Plan of an Annual Harvest of 29 million board feet or over a 5 year period a harvest of about 1.5% of the growth. Build a progressively higher inventory of mature second growth conifer stands.

Initial stand: 40 – 60 year old 2nd growth stand, good site, with 170 – 210 trees per acre, even aged stand with a mixture of redwood, Douglas fir and other more tolerant conifers.

Silvicultural System: Every 5 years harvest about 1.5 % of the inventory or every 10 years harvest about 3 % of inventory. The harvested trees will be removed in an irregular selection system from single tree to small group selection cuts. As the stand grows in age and tree size, trees will be removed in all commercial size classes, allowing 8 – 12 trees per acre to reach old-growth size. If all the conifer species do not regenerate naturally, the absent species will be planted in the irregular size group selection cut areas. These stands will eventually reach an all-aged, all species late seral stand with a reverse "J" shaped curve of tree numbers over size classes.

Near term assessment period, 15 years

Expected changes in species composition:

15 years after the initial and 2nd selection cut the overstory canopy of 55 to 75 year old trees should have the same species composition as the original stand unless some species was favored in the selection cuts.

A new cohort of understory trees will become established in the disturbed areas and under the canopy gaps resulting from the initial two harvesting entries. All cut redwood stumps will sprout and some hemlock and grand fir seedlings will become established. The growth of these seedlings and sprouts will be very slow because of the rapid crown closure of the upper canopy.

The forest floor herbaceous plant community should change in species and amount of cover. Understory plants will germinate in the areas of the forest floor disturbed by the timber harvest and increase in light under the selective cut canopy gaps. As the canopy gaps close with growth of the tree crowns, less light will reach the forest floor and the growth of the understory plants will slow.

Expected changes in forest stand structure

15 years after the initial and 2nd selection cut the overstory canopy of 55- to 75-year old trees will have a more varied canopy structure, both vertically and horizontal. The crowns of the released redwoods will rapidly grow into the new canopy gaps and the lowest branches will not slow in growth or die back but will increase in growth making the tree crowns larger in depth and diameter. As the canopy closes this type of growth will slow. The other canopy conifers, Douglas fir, grand fir and hemlock will increase in the same dimensions as redwood but not as rapid.

A mixed conifer species lower canopy cohort of new seedlings and sprouts will slowly start after the two initial selective timber harvests. These will have very slow growth in height because of the rapid closure of the overstory canopy.

The opening of the dense canopy of 40 – 60 year old trees may have some stand structural changes caused by wind storms. Some trees may have a portion of their upper crown broken off, followed by a branch taking over as the new top leader or in the case of redwood a sprout may take over as the new top leader. Some of the trees with broken tops may turn into snags. Some wind blowdown uproots may occur with varied root wads and holes. The blowdown trees or broken tops will increase the amount of large woody debris (down rotten logs).

Over this 15 year time period there will be tree deaths caused by the competition between the increasing size of the canopy dominants and the suppressed lower canopy trees. This will still occur even though some trees are selectively removed from the overstory canopy.
Depending on how these suppressed trees die, they will form either hard shelled snags or soft shelled snags. Some of these snags will fall and become woody debris.

Development of late successional forest conditions.

The development of late successional forest conditions will be minimal.

Table of late successional forest conditions

Important attributes	**Development in the 15 year near term assessment**
Large diameter trees	Very minimal, very few with deep bark fissures
Large diameter branches	Very minimal, not enough time to develop
Lower canopy tree community	Just starting to develop
Forest floor community	Slowly increasing, minimal herbs, no shrubs
Snags	A minimal number, mostly smaller snags
Large woody debris	A minimal number, mostly small logs
Uproots	Minimal if any
Forest floor humus layer	Very shallow, still developing
Vertical distribution of foliage/canopy	Slowly developing
Horizontal distribution of structure	Increasing because of irregular selection cuts
Canopy gaps	Minimal increase by selection cuts, decreased by crown growth. Minimal development
Anti – gaps	Developing on the lower canopy growth of the new seedlings and sprouts and the canopy closure in the unthinned portion of the upper canopy
Biomass accumulation	The biomass is increasing slowly even with the irregular selection timber harvest
Achievement of maximum height and crown spread per tree	Slowly increasing, not near maximum
Canopy elaboration	Slowly developing
Live tree decadence	Very little of this on the upper canopy trees
Canopy epiphytic community	Not fully developed

100 year term projection of future forest conditions

Silvicultural System: This stand will have had 10 entries of trees cut using an irregular selection from single tree to small group selection cuts. If all the conifers do not regenerate naturally, the absent species will be planted. After 10 selection cut entries over a 100 years, this stand will have an upper 140 – 160 year old upper canopy with approximately 60 – 70 trees per acre. If the stand had not been selectively cut there would be approximately 117 trees per acre at an average age of 150 years.

A new cohort of understory trees from 10 to 100 years of age will form a multi-aged understory canopy.

Expected changes in species composition

The upper relatively even-aged (150 years old) canopy of approximately 60 – 70 trees per acre will consist of redwood and Douglas fir. All the grand fir and hemlock will have been timber harvested, turned into snags or blown down.

The new cohort of understory trees from 10 to 100 years old will consist of redwood sprouts as the dominant tree with an all age – size mixture of redwood, grand fir and hemlock. Douglas fir would not grow under these types of moderate to heavy canopy.

The understory herbaceous plant community should consist of the normal plants consistent with site. On good sites, sword fern, oxalis, trillium etc. with a few huckleberry and salal shrubs will dominate the forest floor cover. Some nonnative understory plants; Himalayan blackberry, English ivy, and holly will probably be present on the forest floor under the forest canopy, with pampas grass in the more open areas.

Expected changes in forest stand structure

100 years after the initial and subsequent 9 other selection cut entries, the overstory canopy will be a relatively even aged uniform upper consisting of approximately 60 – 70 trees per acre, with an average age of 150 years. These will be irregularly spaced from tight clumps with relatively small crowns to openly spaced trees with large crowns. There will be an multi-aged cohort of understory trees from 10 to 100 years of age. These trees will form a fairly dense sub-canopy level of trees.

Development of late successional forest conditions.

The development of late successional forest conditions will be progressing towards the optimum conditions that are found in late successional forests.

Table of late successional forest conditions

Important attributes	Development in the 100 years of selection cuts assessment
Large diameter trees	A few trees per acre will be 5 – 6 ft. in diameter with deep bark fissures starting to develop
Large diameter branches	These are developing on some of the larger released Trees, especially redwood, they will get larger as the stand gets older
Lower canopy tree community	Well developed, multiage, multi-size up to 100 years old
Forest floor community	Fairly high cover of herbaceous except under the anti-gaps
Snags	A small number, of small to medium size
Large woody debris	A small number, mostly small to medium size logs
Uproots	A few per acre
Forest floor humus layer	3 – 4 inches in depth of well developed humus if not disturbed by timber harvest
Vertical distribution of foliage/canopy	Moderate development
Horizontal distribution of structure	Moderate because of irregular selection cuts
Canopy gaps	Varied size from small to fairly large
Anti – gaps	The 10 to 100 year old lower canopy layer will have some very dense areas of canopy
Biomass accumulation	Increasing, even with the selection cuts
Achievement of maximum height and crown spread per tree	Increasing, not near maximum
Canopy elaboration	Even heights of the upper canopy with gaps and anti-gaps in the lower canopy, very complex
Live tree decadence	Some of this on the upper canopy trees
Canopy epiphytic community	Not fully developed, too much exposure to light in the upper canopy

ALTERNATIVE C. LTSY WITH ENHANCED WILDLIFE AND FISHERY HABITAT

Initial Stand: 40 – 60 year old 2nd growth stand, good site, with 170 – 210 trees per acre, even aged stand with a mixture of redwood, Douglas fir and other more tolerant conifers.

Silvicultural System: on a irregular basis each stand will be entered every 25 years to harvest 50% of the growth since the last entry. The harvested trees will be removed in an irregular selection system from single tree to small group selection cuts. As the stand grows in age and tree size, trees will be removed in all commercial size classes. After the oldest trees in the stand reaches 150 years in age, the amount harvested at each entry will be increased to 90 % of growth. This will retain 10 % of the growth to be converted into snags and down coarse woody debris. Harvested trees will range in age from 50 to 150 years. If all the conifer species do not regenerate naturally, the absent species will be planted in the irregular size group selection cut areas. These stands will eventually reach an all-aged, all species late seral stand with a reverse " J " shaped curve of tree numbers over size classes. This type of silvicultural system will optimize the amount of photosynthesis surfaces (crown size) per unit area and optimize timber production.

Near term assessment period, 15 years

Expected changes in species composition

15 years after the initial selection cut the overstory canopy of 55- to 75-year old trees should have the same species composition as the original stand unless some species were favored in the selection cuts.

A new cohort of understory trees will become established in the disturbed areas and under the canopy gaps resulting from the initial two harvesting entries. All cut redwood stumps will sprout and some hemlock and grand fir seedlings will become established. The growth of these seedlings and sprouts will be very slow because of the rapid crown closure of the upper canopy.

The forest floor herbaceous plant community should change in species and amount of cover. Understory plants will germinate in the areas of the forest floor disturbed by the timber harvest and increase in light under the selective cut canopy gaps. As the canopy gaps close with growth of the tree crowns, less light will reach the forest floor and the growth of the understory plants will slow.

Expected changes in forest stand structure

15 years after the initial and selection cuts the overstory canopy of 55- to 75-year old trees will have a more varied canopy structure, both vertically and horizontal. The crowns of the released redwoods will rapidly grow into the new canopy gaps and the lowest branches will not slow in growth or die back but will increase in growth making the tree crowns larger in depth and diameter. As the canopy closes this type of growth will slow. The other canopy conifers, Douglas fir, grand fir and hemlock will increase in the same dimensions as redwood but not as rapid.

A mixed conifer species lower canopy cohort of new seedlings and sprouts will slowly start after the two initial selective timber harvests. These will have very slow growth in height because of the rapid closure of the overstory canopy.

The opening of the dense canopy of 40 – 60 year old trees may have some stand structural changes caused by wind storms. Some trees may have a portion of their upper crown broken off, followed by a branch taking over as the new top leader or in the case of redwood a sprout may take over as the new top leader. Some of the trees with broken tops may turn into snags.

Some wind blowdown uproots may occur with varied root wads and holes. The blowdown trees or broken tops will increase the amount of large woody debris (down rotten logs).

Over this 15 year time period there will be tree deaths caused by the competition between the increasing size of the canopy dominants and the suppressed lower canopy trees. This will still occur even though some trees are selectively removed from the overstory canopy. Depending on how these suppressed trees die, they will form either hard shelled snags or soft shelled snags. Some of these snags will fall and become woody debris.

Development of late successional forest conditions.

The development of late successional forest conditions will be minimal.

Table of late successional forest conditions

Important attributes	**Development in the 15 year near term assessment**
Large diameter trees	Very minimal, very few with deep bark fissures
Large diameter branches	Very minimal, not enough time to develop
Lower canopy tree community	Just starting to develop
Forest floor community	Slowly increasing, minimal herbs, no shrubs
Snags	A minimal number, mostly smaller snags
Large woody debris	A minimal number, mostly small logs
Uproots	Minimal if any
Forest floor humus layer	Very shallow, still developing
Vertical distribution of foliage/canopy	Slowly developing
Horizontal distribution of structure	Increasing because of irregular selection cuts
Canopy gaps	Minimal increase by selection cuts, decreased by crown growth. Minimal development
Anti – gaps	Developing on the lower canopy growth of the new seedlings and sprouts and the canopy closure in the unthinned portion of the upper canopy
Biomass accumulation	The biomass is increasing slowly even with the irregular selection timber harvest
Achievement of maximum height and crown spread per tree	Slowly increasing, not near maximum
Canopy elaboration	Slowly developing
Live tree decadence	Very little of this on the upper canopy trees
Canopy epiphytic community	Not fully developed

100 year term projection of future forest conditions

Silvicultural System: This stand will have had 4 entries of trees cut using an irregular selection system from single tree to small group selection cuts. If all the conifers do not

regenerate naturally, the absent species will be planted. After 4 selection cut entries over a 100 years, this stand will have an upper 140 – 150 year old upper canopy with approximately 60 – 70 trees per acre. If the stand had not been selectively cut there would be approximately 117 trees per acre at an average age of 150 years.

A new cohort of understory trees from 26 to 100 years of age will form a multi-aged understory canopy.

Expected changes in species composition

The upper relatively even-aged (150 years old) canopy of approximately 60 – 70 trees per acre will consist of redwood and Douglas fir. All the grand fir and hemlock will have been timber harvested, turned into snags or blown down.

The new cohort of understory trees from 15 to 100 years old will consist of redwood sprouts as the dominant tree with an all age – size mixture of redwood, grand fir and hemlock. Douglas fir would not grow under these types of moderate to heavy canopy.
The understory herbaceous plant community should consist of the normal plants consistent with site. On good sites, sword fern, oxalis, trillium etc. with a few huckleberry and salal shrubs will dominate the forest floor cover. Some nonnative understory plants; Himalayan blackberry, English ivy, and holly will probably be present on the forest floor under the forest canopy, with pampas grass in the more open areas.

Expected changes in forest stand structure

100 years after the initial and subsequent 3 other selection cut entries, the overstory canopy will be a relatively even aged uniform upper consisting of approximately 60 – 70 trees per acre, with an average age of 150 years. These will be irregularly spaced from tight clumps with relatively small crowns to openly spaced trees from 25 to 100 years of age. These trees will form a fairly dense sub-canopy level of trees.

Development of late successional forest conditions.
The development of late successional forest conditions will be progressing towards the optimum conditions that are found in late successional forests.

Table of late successional forest conditions

Important attributes	**Development in the 100 years of selection cuts assessment**
Large diameter trees	A few trees per acre will be 5 – 6 ft. in diameter with deep bark fissures starting to develop
Large diameter branches	These are developing on some of the larger released trees, especially redwood, they will get larger as the stand gets older
Lower canopy tree community	Well developed, multiage, multi-size up to 100 years old
Forest floor community	Fairly high cover of herbaceous except under the anti-gaps

Important attributes	**Development in the 100 years of selection cuts assessment**
Snags	A small number, of small to medium size
Large woody debris	A small number, mostly small to medium size logs
Uproots	A few per acre
Forest floor humus layer	3 – 4 inches in depth of well developed humus if not disturbed by timber harvest
Vertical distribution of foliage/canopy	Moderate development
Horizontal distribution of structure	Moderate because of irregular selection cuts
Canopy gaps	Varied size from small to fairly large
Anti – gaps	The 10 to 100 year old lower canopy layer will have some very dense areas of canopy
Biomass accumulation	Increasing, since only 50% of the annual growth is cut at each entry
Achievement of maximum height and crown spread per tree	Increasing, not near maximum
Canopy elaboration	Even heights of the upper canopy with gaps and anti-gaps in the lower canopy, very complex
Live tree decadence	Some of this on the upper canopy trees
Canopy epiphytic community	Not fully developed, too much exposure to light in the upper canopy

ALTERNATIVE D. CITIZENS ADVISORY COMMITTEE RECOMMENDATIONS

Initial stand: 40 – 60 year old 2nd growth stand, good site, with 170 – 210 trees per acre, even aged stand with a mixture of redwood, Douglas fir and other more tolerant conifers.

Silvicultural System: on a irregular basis each stand will be entered every 10 to 20 years to harvest 50% of the growth since the last entry. The harvested trees will be removed in an irregular selection system from single tree to small group selection cuts. As the stand grows in age and tree size, trees will be removed in all commercial size classes, allowing 8 – 12 trees per acre to reach old-growth size. Harvested trees will range in age from 50 to 150 years. If all the conifer species do not regenerate naturally, the absent species will be planted in the irregular size group selection cut areas. These stands will eventually reach an all-aged, all species late seral stand with a reverse " J " shaped curve of tree numbers over size classes.

Near term assessment period, 15 years

Expected changes in species composition

15 years after the initial selection cut the overstory canopy of 55 to 75 year old trees should have the same species composition as the original stand unless some species were favored in the selection cuts.

A new cohort of understory trees will become established in the disturbed areas and under the canopy gaps resulting from the initial two harvesting entries. All cut redwood stumps will sprout and some hemlock and grand fir seedlings will become established. The growth of these seedlings and sprouts will be very slow because of the rapid crown closure of the upper canopy.

The forest floor herbaceous plant community should change in species and amount of cover. Understory plants will germinate in the areas of the forest floor disturbed by the timber harvest and increase in light under the selective cut canopy gaps. As the canopy gaps close with growth of the tree crowns, less light will reach the forest floor and the growth of the understory plants will slow.

Expected changes in forest stand structure

15 years after the initial and selection cuts the overstory canopy of 55 to 75 year old trees will have a more varied canopy structure, both vertically and horizontal. The crowns of the released redwoods will rapidly grow into the new canopy gaps and the lowest branches will not slow in growth or die back but will increase in growth making the tree crowns larger in depth and diameter. As the canopy closes this type of growth will slow. The other canopy conifers, Douglas fir, grand fir and hemlock will increase in the same dimensions as redwood but not as rapid.

A mixed conifer species lower canopy cohort of new seedlings and sprouts will slowly start after the two initial selective timber harvests. These will have very slow growth in height because of the rapid closure of the overstory canopy.

The opening of the dense canopy of 40 – 60 year old trees may have some stand structural changes caused by wind storms. Some trees may have a portion of their upper crown broken off, followed by a branch taking over as the new top leader or in the case of redwood a sprout

may take over as the new top leader. Some of the trees with broken tops may turn into snags. Some wind blowdown uproots may occur with varied root wads and holes. The blowdown trees or broken tops will increase the amount of large woody debris (down rotten logs).

Over this 15 year time period there will be tree deaths caused by the competition between the increasing size of the canopy dominants and the suppressed lower canopy trees. This will still occur even though some trees are selectively removed from the overstory canopy.
Depending on how these suppressed trees die, they will form either hard shelled snags or soft shelled snags. Some of these snags will fall and become woody debris.

Development of late successional forest conditions.
The development of late successional forest conditions will be minimal.

Table of late successional forest conditions

Important attributes	**Development in the 15 year near term assessment**
	Very minimal, very few with deep bark fissures
	Very minimal, not enough time to develop
	Just starting to develop
	Slowly increasing, minimal herbs, no shrubs
	A minimal number, mostly smaller snags
	A minimal number, mostly small logs
	Minimal if any
	Very shallow, still developing
	Slowly developing
	Increasing because of irregular selection cuts
	Minimal increase by selection cuts, decreased by crown growth. Minimal development
	Developing on the lower canopy growth of the new seedlings and sprouts and the canopy closure in the unthinned portion of the upper canopy
	The biomass is increasing slowly even with the irregular selection timber harvest
	Slowly increasing, not near maximum
	Slowly developing
	Very little of this on the upper canopy trees
	Not fully developed

100 year term projection of future forest conditions

Silvicultural System: This stand will have had 5 to 10 entries of trees cut using an irregular selection system from single tree to small group selection cuts. If all the conifers do not regenerate naturally, the absent species will be planted. After 10 selection cut entries over a

100 years, this stand will have an upper 140 – 160 year old upper canopy with approximately 60 – 70 trees per acre. If the stand had not been selectively cut there would be approximately 117 trees per acre at an average age of 150 years.

A new cohort of understory trees from 10 to 100 years of age will form a multi-aged understory canopy.

Expected changes in species composition

The upper relatively even-aged (150 years old) canopy of approximately 60 – 70 trees per acre will consist of redwood and Douglas fir. All the grand fir and hemlock will have been timber harvested, turned into snags or blown down.

The new cohort of understory trees from 15 to 100 years old will consist of redwood sprouts as the dominant tree with an all age – size mixture of redwood, grand fir and hemlock. Douglas fir would not grow under these types of moderate to heavy canopy.

The understory herbaceous plant community should consist of the normal plants consistent with site. On good sites, sword fern, oxalis, trillium etc. with a few huckleberry and salal shrubs will dominate the forest floor cover. Some nonnative understory plants; Himalayan blackberry, English ivy, and holly will probably be present on the forest floor under the forest canopy, with pampas grass in the more open areas.

Expected changes in forest stand structure

100 years after the initial and subsequent 4 - 9 other selection cut entries, the overstory canopy will be a relatively even aged uniform upper consisting of approximately 60 – 70 trees per acre, with an average age of 150 years. These will be irregularly spaced from tight clumps with relatively small crowns to openly spaced trees with large crowns. There will be an multi-aged cohort of understory trees from 10 to 100 years of age. These trees will form a fairly dense sub-canopy level of trees.

Development of late successional forest conditions.
The development of late successional forest conditions will be progressing towards the optimum conditions that are found in late successional forests.

Table of late successional forest conditions

Important attributes	**Development in the** 100 years of selection cuts **assessment**
Large diameter trees	A few trees per acre will be 5 – 6 ft. in diameter with deep bark fissures starting to develop
Large diameter branches	These are developing on some of the larger released trees, especially redwood, they will get larger as the stand gets older
Lower canopy tree community	Well developed, multiage, multi-size up to 100 years old

Forest floor community	Fairly high cover of herbaceous except under the anti-gaps
Snags	A small number, of small to medium size
Large woody debris	A small number, mostly small to medium size logs
Uproots	A few per acre
Forest floor humus layer	3 – 4 inches in depth of well developed humus if not disturbed by timber harvest
Vertical distribution of foliage/canopy	Moderate development
Horizontal distribution of structure	Moderate because of irregular selection cuts
Canopy gaps	Varied size from small to fairly large
Anti – gaps	The 10 to 100 year old lower canopy layer will have some very dense areas of canopy
Biomass accumulation	Increasing, since only 50% of the annual growth is cut at each entry
Achievement of maximum height and crown spread per tree	Increasing, not near maximum
Canopy elaboration	Even heights of the upper canopy with gaps and anti-gaps in the lower canopy, very complex
Live tree decadence	Some of this on the upper canopy trees
Canopy epiphytic community	Not fully developed, too much exposure to light in the upper canopy.

ALTERNATIVE E (LATE SERAL EMPHASIS)

Use of silviculture to develop late seral characteristics

Initial stand: 40 – 60 year old 2nd growth stand, good site, with 170 – 210 trees per acre, even aged stand.

Uniform selection cut: 1/3 of the trees, 60 – 70 trees, are removed uniformly through the stand, leaving the remaining trees equally spaced.

Development of late seral characteristics, 15 years after this uniform selection cut.

The leave redwood trees will accelerate the growth of larger branches, fuller and longer crowns. This will occur in the first 15 years following the uniform selection cut. The accelerated growth of the redwoods will slightly increase the depth of the furrows in the bark on the lower portions of the tree trunks. Following the uniform selection cut a young age class of trees will develop on the forest floor. Most of newly cut redwood stumps will sprout along with the seeding of grand fir and W. hemlock seedlings. Understory plants; oxalis, sword fern and others will increase in the amount of cover. If present in the stand the amount of canopy lichen and bryophytes will increase in the deeper and fuller crown.

Depending upon the location of this stand, storm winds could blowdown some of the canopy trees, after the initial uniform selection cuts before the crowns close after 10 – 15 years. This would create some down logs, uproot mounds and broken tops of standing trees that could turn into snags or create potential nesting platforms. Wind damage to crowns and branches would develop irregular new sprouting branch clumps and cavities, which would provide potential nesting sites.

Depending upon the site, the crowns of the leave trees will have closed the canopy in approximately 10 – 15 years. After this crown closure the development of larger individual crowns will decline. The lower amount of light reaching the forest floor will retard the growth the new redwood sprouts, new tree seedlings and the understory plants. Some of these new seedlings and redwood sprouts will die from the lack of light with the more tolerant Western hemlock and Grand fir persisting as an understory tree layer.

100 years after the uniform selection cut.

After this crown closure the stand will slowly develop as a uniform even-aged stand. The trees will slow their development of fuller and larger crowns and development of large branches. As the crown of the stand closes less blowdown will occur. This will lessen the rate of the development of late seral characteristics. As this stand ages from 40 – 60 years old for a hundred years the stand will slowly self thin itself to 70 – 90 trees per acre. This self-thinning will slowly create a more diverse canopy and size of trees and the gradually dying of trees creating snags and down logs. Since redwoods are somewhat shade tolerant and live for 100's of years this gradual self-thinning will not develop many late seral characteristics. Very few natural canopy gaps will develop in this 100-year time period. This will delay the development of a lower cohort of younger trees. The vertical distribution of foliage/canopy will be slow in developing. The horizontal distribution of structure will tend to be uniform until more gaps are formed to allow regeneration of trees. In general the development of late seral structural characteristics will be very slow in this 100 year time period following the crown closure at age 10 – 15 years following the initial uniform selection cuts.

APPENDIX 8B
DETAILED ANALYSIS OF EIR PROJECT ALTERNATIVES
TO THE PROPOSED ACTION
(ALTERNATIVES #A, #B, #D, AND #E)
AQUATIC RESOURCES

1. ALTERNATIVE A. (NO DIRECT MANAGEMENT ACTIVITY).

Alternative A describes the effects of only minimal maintenance and protection of JDSF lands. There would be no harvest of timber. Road maintenance would be limited to that necessary to maintain public access. Stand structure would change more slowly than in an active management strategy. The demonstration value of this alternative is limited to forest development that is not likely on most private lands in the state. The primary land uses on JDSF would be public recreation and monitoring or study of natural environmental processes.

Project Impact: ***Have substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive or special status species.***

Indirect effects to instream habitat may include, but are not limited to, changes in water temperature resulting from reductions in stream shading; increased sedimentation resulting from increased erosion, reduced recruitment of LWD, alteration of flow patterns resulting from changes in runoff characteristics, and changes in stream channel morphology.

Water Temperature

Most of JDSF's watercourses currently have water temperature regimes that meet target criteria. Those reaches not meeting target criteria are generally larger order streams such as the mid- to lower South Fork Noyo River or the North Fork Big River in the eastern portion of the Forest. The cessation of direct timber management activities would allow for the continued development of the riparian zones along watercourses, which may lead to further reductions in water temperatures. (Beneficial Impact)

Sedimentation

Sediment delivery from the portion of the road system not required for recreational or research purposes would likely increase over time due to lack of maintenance and upgrading. Erosion locations would likely be culverted crossings that fail releasing their fill into the channel. Another scenario could occur due to plugged culverts that cause diversions that erode the road prism and/or create gullies where the flow leaves the running surface. This would lead to degradation of spawning and rearing habitat and possibly retard continued improvements in stream habitat. (Significant Impact)

LWD Recruitment

LWD recruitment to streams would gradually improve overtime under Alternative A since no timber would be harvested from the WLPZs. However, thinning of small diameter dense timber stands to develop large diameter trees at a faster rate would not be allowed under Alternative A. Therefore, LWD recruitment from small dense stands would likely be slower than other alternatives where thinning or selection harvesting would be allowed. (Beneficial Impact)

Flow Patterns

Flow patterns could be expected to change for the worse as culverts plug due to lack of maintenance and water is diverted down roads increasing erosion risk due to gully development or downcutting of the receiving tributary channels. (Significant Impact)

See Hydrology section for peak flow analysis.

Channel Geomorphology

Channel geomorphology may be adversely affected due to increased sediment delivery from failing road system. Pools may lose some depth, gravel interstices could fill, and channel could lose volume. However, increased LWD inputs could help route and store sediment. (Significant Impact)

Project Impact: ***Potential to interfere substantially with movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites.***

Migration barriers affect salmonids by restricting access by juveniles to higher quality habitats and inhibiting or halting adult entry to spawning grounds. In landscapes altered by anthropogenic activities, barriers to migration usually involve improper placement of stream crossings or development of thermal barriers during the summer.

Fish migration may be adversely affected by Alternative A since there will be no inventory or management of roads not necessary for recreation or research purposes. This could result in few of the Class I watercourse crossings being analyzed for fish passage problems. Increased sediment delivery from non-maintained roads could fill pools and gravel interstices, reducing egg incubation and rearing habitat quality. (Significant Impact)

Project Impact: Potential to have a substantial effect on any riparian habitat.

The presence of riparian vegetation adjacent to stream channels and within the flood prone area contributes to streambank stability, allochthonous inputs (leaf litter and terrestrial invertebrates), and instream habitat. Vegetative root structure reinforces streambanks to resist erosional forces. Leaf litter provides the trophic base for aquatic macro-invertebrates, which are an important food source

for fish. LWD inputs from the riparian zone provide cover habitat for salmonids, promote streambed scour and pool development, sort and store sediment, and slow water velocities. These riparian functions have a direct bearing on the quality of salmonid spawning and rearing habitat.

Streambank Stability

Timber harvesting activities have the potential to destabilize streambanks by removing trees whose roots provide erosional resistance to flows. As roots decay (non-redwoods) banks could fail and undercuts that are preferred fish habitat could be lost. As streambanks fail the channel widens and the cross-sectional area of increases. The increase in cross-sectional area reduces stream velocities during runoff events and the ability of the watercourse to transport sediment. Reduced sediment transport ability could result in channel aggradation and decreases in the quantity and quality of spawning and rearing habitat. Alternative A will not result in the removal of riparian vegetation that helps stabilize the streambank. (No Impact)

Allochthonous Inputs

Riparian vegetation can provide nutrient inputs to the stream ecosystem in at least two ways: terrestrially derived invertebrates and as leaf litter. LWD can also function as a substrate and nutrient source for aquatic macro-invertebrates. The degree to which the riparian zone can provide invertebrates, leaf litter, and LWD has a direct relationship on the production of food resources for salmonids. Timber harvesting can reduce allochthonous inputs through direct removal of timber and vegetative cover thereby having some impact on salmonid food resources. Alternative A will not remove any riparian vegetation that contributes allochthonous inputs. (No Impact)

Instream Habitat

As previously discussed and analyzed, riparian vegetation contributes to instream habitat in a number of ways. Riparian canopy closure reduces the amount of solar radiation reaching the watercourse thereby moderating water temperatures. LWD provide roughness elements that cause flow turbulence resulting in pool scour and development. The turbulent flow also helps contributes to fine sediment mobilization and transport. Riparian root structure can be undercut and provide holding and rearing habitat for adult and juvenile fish while stabilizing streambanks. Riparian areas also provide fish with velocity refuge areas during overbank flood flows. Instream LWD provides critical winter cover for flows that don't overtop banks. Alternative A will not remove any riparian vegetation that could contribute LWD to watercourses and improve instream habitat condition. (Beneficial Impact)

Project Impact: ***Conflicts with provisions of an adopted HCP or other approved local, state, or federal HCP relating to aquatic resources.***

There are no approved or adopted HCPs pertaining to JDSF. (No Impact)

Project Impact: ***Causes a fish population to drop below self-sustaining levels or threaten to eliminate an aquatic community***

Fish populations can be extirpated from watercourses and watersheds should conditions degrade to a point the stocks are no longer self-sustainable. However, nearly two-thirds of the entire land base within the JDSF was clear-cut and burned prior to the introduction of the modern FPR. Historic activities included massive broadcast burning, road construction and log skidding in watercourses, splash damming, stream clearing, and complete removal of riparian canopy. No effort was made to protect fish populations at that time. During the first season of operation the Noyo River egg taking station recorded a 1962-1963 coho run of 1,191 adults and 2,501 grilse. This indicates fish populations were able to maintain themselves through that unregulated logging period. The potential effects to fish populations and aquatic communities from each alternative are orders of magnitude less than pre-modern FPR operations. (Less than Significant Impact)

Project Impact: ***Reduce the number or restrict the range of a rare or endangered aquatic plant or animal***

There are no rare or endangered aquatic plants on JDSF. Coho salmon and steelhead trout are listed as "Threatened" under the federal ESA and are currently considered for listing under the California ESA. Instream sediment and LWD loads and pool shelter in JDSF currently fail to meet target criteria or desired levels in most cases. In addition, State personnel on the Forest have identified a number of definite or potential migration barriers. Alternative A does not include the Road Management Plan contained in Alternatives C, D, and E. Road failures could result in further degradation of spawning and rearing habitat and reduce the numbers salmonids. (Significant Impact)

2. ALTERNATIVE B. (MANAGEMENT REMAINS CONSISTENT WITH 1984 MANAGEMENT PLAN).

Alternative B describes JDSF maintaining the current level of forest management demonstration, timber production, recreational development, and environmental protection consistent with the 1984 Management Plan. It includes an annual timber harvest of about 29 million board feet and conservative harvesting practices that meet or exceed the requirements of the FPR. This alternative includes protection of listed species, and recruitment of recovery habitat for listed species as opportunities arise. A demonstration program is included that explores basic forest processes. It also includes the maintenance of existing recreational facilities. This alternative accommodates changes in laws and regulations that affect management activities, particularly changes in the FPR and the Endangered Species Act.

Project Impact: ***Have substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive or special status species.***

Indirect effects to instream habitat may include, but are not limited to, changes in water temperature resulting from reductions in stream shading; increased sedimentation resulting from increased erosion, reduced recruitment of LWD, alteration of flow patterns resulting from changes in runoff characteristics, and changes in stream channel morphology.

Water Temperatures

Most of JDSF's watercourses currently have water temperature regimes that meet target criteria. Those reaches not meeting target criteria are generally larger order streams such as the mid- to lower South Fork Noyo River or the North Fork Big River in the eastern portion of the Forest. Alternative B would allow harvest in WLPZs consistent with the FPR. Current FPR for watersheds with threatened or impaired values require the largest 10 conifers (5 each side) and 85% overstory be retained within 50 and 75 feet of a Class I, respectively. The remainder of the Class I WLPZ has a 65% overstory canopy retention standard. Class II watercourse retention requires 50% total canopy retention with at least 25% of the existing conifer overstory. Much of the timber harvesting in JDSF was conducted using FPR with lower WLPZ retention standards than those stated above. Therefore, since most water temperatures already meet target criteria, it can be assumed that the higher retention standard will maintain or improve conditions. (Less than Significant Impact)

Sedimentation

Alternative B does not require a road management program beyond the one to three (threatened or impaired watersheds) years mandated by the FPR. However, although JDSF has actively maintained the Forest road system for many years, there is no requirement to continue to do so. Budgetary constraints may result in reductions in maintenance activities. In addition, Alternative B does not require a sediment source inventory of the transportation system or systematically plan for road improvement or abandonment projects. Sediment delivery from a road system that is not required to be maintained could increase overtime due to lack of maintenance and upgrading. Erosion locations would likely be culverted crossings that fail, releasing their fill into the channel. Another

scenario could occur due to plugged culverts that cause diversions that erode the road prism and/or create gullies where the flow leaves the running surface. This could lead to degradation of spawning and rearing habitat. (Significant Impact)

LWD Recruitment

LWD levels on JDSF are less than 1/3 of that found in old growth systems primarily due to focused stream clearing activities prior to the introduction of the FPR. LWD recruitment to streams may eventually improve overtime under Alternative B since the FPR for watersheds with threatened or impaired values require (at a minimum) the largest 10 conifers (5 each side) and 85% overstory be retained within 50 and 75 feet of a Class I watercourse, respectively. However, the current shortage of LWD on JDSF is affecting instream habitat quality and higher retention standards may be desirable in LWD limited watercourses. (Significant Impact – Mitigation Feasible)

Flow Patterns

Flow patterns could change under Alternative B. Alternative B does not include a road management program beyond the one to three (threatened or impaired watersheds) years mandated by the FPR. It is possible that lack of maintenance could result in changing flow patterns as culverts plug and water is diverted down roads. This increases erosion risk due to gully development or downcutting of the receiving tributary channels. See Hydrology section for peak flow analysis. (Significant Impact)

Channel Geomorphology

Channel geomorphology may be adversely affected due to increased sediment delivery from failing road system. Pools may lose some depth, gravel interstices could fill, and channel could lose volume. However, increased LWD inputs could help route and store sediment. (Significant Impact)

Project Impact: ***Potential to interfere substantially with movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites.***

The FPR require planned operations not result in any measurable blockages to migration. However, Alternative B may adversely affect fish migration since there is no requirement to inventory crossings or maintain roads beyond three years following completion of a THP. This could result in increased sediment delivery from non-maintained roads that could fill pools and gravel interstices, reducing egg incubation and rearing habitat quality. (Significant Impact)

Project Impact: ***Potential to have a substantial effect on any riparian habitat.***

Streambank Stability

Timber harvesting activities have the potential to destabilize streambanks by removing trees whose roots provide erosional resistance to flows. However, the FPR require consideration and protection of streambank stability at the THP level. (Significant Impact – Mitigation Feasible)

Allochthonous Inputs

Timber harvesting can reduce allochthonous inputs through direct removal of timber and vegetative cover thereby having some impact on salmonid food resources. However, the FPRs for watersheds with threatened or impaired values require (at a minimum) the largest 10 conifers (5 each side) and 85% overstory be retained within 50 and 75 feet of a Class I watercourse, respectively. The remainder of the Class I WLPZ has a 65% overstory canopy retention standard. (Less than Significant Impact)

Instream Habitat

As previously discussed and analyzed, riparian vegetation contributes to instream habitat in a number of ways. Riparian canopy closure reduces the amount of solar radiation reaching the watercourse thereby moderating water temperatures. LWD provide roughness elements that cause flow turbulence resulting in pool scour and development. The FPR for watersheds with threatened or impaired values require (at a minimum) the largest 10 conifers (5 each side) and 85% overstory be retained within 50 and 75 feet of a Class I watercourse, respectively. The remainder of the Class I WLPZ has a 65% overstory canopy retention standard. These rules may be sufficient not to degrade conditions in watercourses that have adequate LWD loads. However, riparian silviculture may reduce LWD recruitment potential in watercourses where instream wood loads are low, thereby affecting instream habitat. (Significant Impact)

Project Impact: ***Conflicts with provisions of an adopted HCP or other approved local, state, or federal HCP relating to aquatic resources.***

There are no approved or adopted HCPs pertaining to JDSF. (No Impact)

Project Impact: ***Causes a fish population to drop below self-sustaining levels or threaten to eliminate an aquatic community***

Fish populations can be extirpated from watercourses and watersheds should conditions degrade to a point the stocks are no longer self-sustainable. However, nearly two-thirds of the entire land base within the JDSF was clear-cut and burned prior to the introduction of the modern FPR. Historic activities included massive broadcast burning, road construction and log skidding in watercourses, splash damming, stream clearing, and complete removal of riparian canopy. No effort was made to protect fish populations at that time. During the first season of operation the Noyo River egg taking

station recorded a 1962-1963 coho run of 1,191 adults and 2,501 grilse. This indicates fish populations were able to maintain themselves through that unregulated logging period. The potential effects to fish populations and aquatic communities from each alternative are significantly less than pre-modern FPR operations. (Less than Significant Impact)

Project Impact: ***Reduce the number or restrict the range of a rare or endangered aquatic plant or animal***

Alternative B does not include the Road Management Plan contained in Alternatives C, D, and E. Road failures could result in further degradation of spawning and rearing habitat and reduce the numbers salmonids. (Significant Impact)

3. ALTERNATIVE D (CITIZEN'S ADVISORY COMMITTEE).

This alternative was developed from recommendations of a seventeen-member committee of interested persons appointed former Director Wilson. The primary goal for management of JDSF would be conversion of the entire forest into an all-aged forest. There would be no harvest of old-growth trees and even-age regeneration methods would not be used. No herbicides would be used. Rotation ages would range from 50 to 150 years in various demonstration harvests. Riparian zones for all watercourse classes would be protected by using harvest limitations similar to the USFS methods described in the FEMAT (Federal Ecosystem Management Assessment Team 1993) Report. Riparian zones would be managed to establish late successional habitat. Recreation would be emphasized, including increasing the number of hiking trails and campsites. Timber harvesting would be compatible with the recreation uses. Demonstrations and research would emphasize management alternatives for singletree selection and other all-aged silvicultural methods for small landowners. Hardwood management and use would be another demonstration emphasis.
This alternative represents a low to moderate level of timber production with specific management constraints, a high level of watershed protection, and a moderate to high level of recreational development. Aquatic protection standards include the following:

- Class I Watercourses. FPR protections plus FEMAT standards of 340-foot no-cut buffers that will be managed to establish late successional habitats.
- Class II Watercourses. FPR protections plus FEMAT standards of 170-foot no-harvest buffers that will be managed to establish late successional habitats.
- Class III Watercourses. FPR protections plus FEMAT standards of 100-foot no-harvest buffers that will be managed to establish late successional habitats.
- Road Management Plan as described in Alternative C.

It must be noted that the FEMAT riparian reserve standards are interim prescriptions that are in place until a watershed analysis is completed, a site-specific analysis is conducted and described, and the rationale for final riparian reserve boundaries is presented (FEMAT 1993). Interim widths are designed to provide a high level of fish habitat and riparian protection until watershed and project analysis can be completed (FEMAT 1993).

Project Impact: ***Potential to have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive or special status species in local or regional plans, policies, or regulations, or by the CDFG or U.S. Fish and Wildlife Service***

Water Temperatures

Most of JDSF's watercourses currently have water temperature regimes that meet preferred target criteria. Those reaches not meeting target criteria are generally larger order streams such as the mid- to lower South Fork Noyo River or the North Fork Big River in the eastern portion of the Forest. Alternative D would allow harvest in WLPZs only to establish late successional habitats. Much of the timber harvesting in JDSF was conducted using FPR with lower WLPZ retention standards than those stated above. Therefore, if most water temperatures meet target criteria, it can be assumed that the higher retention standard of Alternative D will improve conditions. (Less than Significant Impact)

Sedimentation

Alternative D includes the road management program described in Alternative C. Sediment delivery from roads will be reduced in the next five years due to the inventory, upgrading, abandonment, and winter inspection portions of the road maintenance plan. Sediment delivery from mass wasting or unstable hillslope locations should be reduced over the current by implementing the hillslope management activities stated in Alternative C with the additional mitigations stated in the Geology analysis. Stream conditions have been improving under the current FPRs and this alternative should not impede that recovery. It can be assumed that the higher level of protection provided by this alternative should accelerate recovery of instream habitat. (Less than Significant Impact)

LWD Recruitment

LWD levels on JDSF are less than 1/3 of those found in old growth systems primarily due to historic logging and focused stream-clearing activities prior to the introduction of the FPR. LWD recruitment to streams should eventually improve overtime under Alternative D due to the heavy WLPZ retention standards. Management activities in WLPZs will be limited to the establishment of late successional stands. This could include singletree selection to allow for development of larger trees at a faster rate than unentered stands. (Less Than Significant Impact)

Flow Patterns

This alternative includes the road management program described in Alternative C. Implementation of the plan should significantly reduce hydrologic connections to the road system, diversion potential, crossing failure, and gully formation. (Less Than Significant Impact)

Channel Geomorphology

The implementation of the Road Management Plan and use of a CEG on THPs should reduce sediment delivery below current conditions and not result in further degradation of channel geomorphology. The use of FEMAT-style WLPZ tree retention standards should result in improvement to instream LWD loads. (Less Than Significant Impact)

Project Impact: *Potential to interfere substantially with movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites*

Fish migration may improve under Alternative D. Planned operations not result in any measurable blockages to migration. The road upgrade component of the Road Management Plan will correct problem culverts and have a beneficial impact on fish migration and rearing habitat. The road upgrade component of the Road Management Plan will correct problem culverts and have a beneficial impact on fish migration and rearing habitat. (Beneficial)

Project Impact: ***Potential to have a substantial effect on any riparian habitat.***

Streambank Stability

Alternative D establishes FEMAT- style WLPZs on Class I and II watercourses (except for late successional habitat enhancement) that reduces the potential for loss of streambank stability due to tree removal to a less than significant level. (Less than Significant Impact)

Allochthonous Inputs

Alternative D establishes FEMAT- style WLPZs on Class I and II watercourses (except for late successional habitat enhancement) that reduce the potential for loss of allochthonous inputs to a less than significant level. (Less than Significant Impact)

Instream Habitat

As previously discussed and analyzed, riparian vegetation contributes to instream habitat in a number of ways. Riparian canopy closure reduces the amount of solar radiation reaching the watercourse thereby moderating water temperatures. LWD provide roughness elements that cause flow turbulence resulting in pool scour and development. Riparian areas also provide fish with velocity refuge areas during overbank flood flows. Instream LWD provides critical winter cover for flows that don't overtop banks. Soil disturbance in WLPZs could result in delivery of sediment to watercourses that could affect spawning and rearing habitat quality and quantity.

Alternative D currently proposes FEMAT- style WLPZs on Class I and II watercourses (except for late successional habitat enhancement) that reduce the potential to adversely affect instream habitat to an insignificant level. (Less than Significant Impact)

Project Impact: ***Conflicts with provisions of an adopted HCP or other approved local, state, or federal HCP relating to aquatic resources.***

There are no approved or adopted HCPs pertaining to JDSF. (No Impact)

Project Impact: ***Causes a fish population to drop below self-sustaining levels or threaten to eliminate an aquatic community.***

Fish populations can be extirpated from watercourses and watersheds should conditions degrade to a point the stocks are no longer self-sustainable. However, nearly two-thirds of the entire land base within the JDSF was clear-cut and burned prior to the introduction of the FPR. Historic activities included massive broadcast burning, road construction and log skidding in watercourses, splash damming, stream clearing, and complete removal of riparian canopy. No effort was made to protect fish populations at that time. During the first season of operation the Noyo River egg taking station recorded a 1962-1963 coho run of 1,191 adults and 2,501 grilse. This indicates fish populations

were able to maintain themselves through that unregulated logging period. The potential effects to fish populations and aquatic communities from each alternative are orders of magnitude less than pre-FPR operations.

Implementation of Alternative D will likely reduce management-related sediment inputs, not increase water temperatures, and allow for continued improvement in instream habitat quality. (Less than Significant Impact)

Project Impact: ***Reduce the number or restrict the range of a rare or endangered aquatic plant or animal.***

There are no rare or endangered aquatic plants on JDSF. Coho salmon and steelhead trout are listed as "Threatened" under the federal ESA and are currently considered for listing under the California ESA. Timber management activities have been identified as a contributing factor in the decline of salmonids throughout northwestern California. Changes in aquatic habitat conditions including elevation of water temperatures, increased sedimentation, reduced instream LWD loads, and altered flow patterns have been identified as factors in the decline of salmonid populations.

Instream sediment and LWD loads and pool shelter in JDSF currently fail to meet target criteria or desired levels in most cases. In addition, State personnel on the Forest have identified a number of definite or potential migration barriers. The Road Management Plan will inventory and correct the road related sediment problems and migration barriers associated with the road system. The implementation of Alternative D may result in improved habitat conditions, salmonid access to spawning and rearing areas, and fish numbers. (Less than Significant Impact)

4. ALTERNATIVE E (LATE SERAL EMPHASIS).

This alternative includes many of the public's interests expressed during scoping, with an emphasis on development of late seral forests across the landscape. Restoration of the natural forest ecosystem and the protection of water quality, fish, and wildlife habitats at JDSF would be the primary management goals. There would be no even-aged management or harvest of old-growth trees. Timber harvesting, when it occurred, would be designed to advance timber stand development to late seral characteristics. Any revenues generated would be utilized for forest maintenance and restoration activities on JDSF. Low impact recreational opportunities such as trails and hike-in campsites would be expanded where they did not pose significant risk to fish and wildlife resources. Research would no longer address questions on active forest management, but would shift to studying the existing vegetation types and watercourse conditions and how they change over time. A research, demonstration, and monitoring program would be implemented to gain and distribute knowledge on the restoration of old-growth and late-seral forests, natural watersheds, and associated resources.

Project Impact: ***Potential to have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive or special status species in local or regional plans, policies, or regulations, or by the CDFG or U.S. Fish and Wildlife Service.***

Water Temperatures

Most of JDSF's watercourses currently have water temperature regimes that meet preferred target criteria. Those reaches not meeting target criteria are generally larger order streams such as the mid- to lower South Fork Noyo River or the North Fork Big River in the eastern portion of the Forest. Alternative E would allow harvest in WLPZs only to manage and establish late successional habitats. Much of the timber harvesting in JDSF was conducted using FPR with lower WLPZ retention standards than those stated above. Therefore, since most water temperatures currently meet target criteria, it can be assumed that the higher retention standard of Alternative E will not degrade conditions. (Less Than Significant Impact)

Sedimentation

Alternative E includes the road management plan described in Alternative C, but with a more aggressive abandonment program. Sediment delivery from roads will be reduced in the next five years due to the inventory, upgrading, abandonment, and winter inspection portions of the road maintenance plan. Sediment delivery from mass wasting or unstable hillslope locations should be reduced over the current condition by avoiding any harvesting in inner gorges, landslides, and WLPZs (except for establishment of late seral habitats). Stream conditions have been improving under the current FPRs and this alternative should not impede that recovery. (Less than Significant Impact)

LWD Recruitment

LWD levels on JDSF are less than 1/3 of that found in old growth systems primarily due to historic logging and focused stream-clearing activities prior to the introduction of the FPR. LWD recruitment to streams should eventually improve overtime under Alternative E due to the heavy WLPZ retention standards. Management activities in WLPZs will be limited to the establishment of late successional stands. This could include singletree selection to allow for development of larger trees at a faster rate than unentered stands. (Less Than Significant Impact)

Flow Patterns

Flow patterns are expected to improve under Alternative E. This alternative includes the road management plan and an aggressive abandonment program. Implementation of the plan should significantly reduce hydrologic connections to the road system, diversion potential, crossing failure, and gully formation. (Less Than Significant Impact)

Channel Geomorphology

The implementation of an aggressive road abandonment program within the Road Management Plan, use of a CEG on THPs, and decreased timber harvesting should reduce sediment delivery below current conditions and not result in further degradation of channel geomorphology. (Less Than Significant Impact)

Project Impact: ***Potential to interfere substantially with movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites***

Fish migration may improve under Alternative E. Planned operations not result in any measurable blockages to migration. The road upgrade component of the Road Management Plan will correct problem culverts and have a beneficial impact on fish migration and rearing habitat. The road upgrade component of the Road Management Plan and abandonment program will correct problem culverts and have a beneficial impact on fish migration and rearing habitat. (Beneficial)

Project Impact: ***Potential to have a substantial effect on any riparian habitat.***

Streambank Stability

Alternative E establishes FEMAT- style WLPZs on Class I and II watercourses (except for late successional habitat enhancement) that reduces the potential for loss of streambank stability due to tree removal to a less than significant level. (Less than Significant Impact)

Allochthonous Inputs

Alternative E establishes FEMAT- style WLPZs on Class I and II watercourses (except for late successional habitat enhancement) that reduce the potential for loss of allochthonous inputs to a less than significant level. (Less than Significant Impact)

Instream Habitat

Alternative E currently proposes FEMAT- style WLPZs on Class I and II watercourses (except for late successional habitat enhancement) that reduce the potential to adversely affect instream habitat to an insignificant level. (Less than Significant Impact)

Project Impact: ***Conflicts with provisions of an adopted HCP or other approved local, state, or federal HCP relating to aquatic resources.***

There are no approved or adopted HCPs pertaining to JDSF. (No Impact)

Project Impact: ***Causes a fish population to drop below self-sustaining levels or threaten to eliminate an aquatic community.***

Implementation of Alternative D will likely reduce management-related sediment inputs, not increase water temperatures, and allow for continued improvement in instream habitat quality. (Less than Significant Impact)

Project Impact: ***Reduce the number or restrict the range of a rare or endangered aquatic plant or animal.***

The Road Management Plan will inventory and correct the road related sediment problems and migration barriers associated with the road system. The implementation of Alternative E may result in improved habitat conditions, salmonid access to spawning and rearing areas, and fish numbers. (Less than Significant Impact)

APPENDIX 8C
AQUATIC RESOURCES

1. AQUATIC HABITAT

This section describes the current aquatic habitat conditions within Jackson Demonstration State Forest (JDSF). Within watersheds containing the JDSF there are approximately 206 miles (331 km) of Class I (fish-bearing) streams, 362 miles (583 km) of Class II streams, and 339 miles (546 km) of Class III streams. The estimated mileage of Class III streams will likely increase, based on project- and site-specific field investigations. On JDSF, the estimated stream miles for Class I, II, and III streams are 98 miles (157 km), 186 miles (299 km), and 174 miles (280 km), respectively (See Map C).

Data describing current aquatic and riparian habitat conditions for streams in JDSF were gathered from several sources. The information presented in this section reflects the analysis and incorporation of data from:

- Stream inventories conducted by the California Department of Fish and Game (DFG) (1995, 1996b, 1997, 1999)
- 1997 stream channel surveys and watershed analysis work conducted by Stillwater Sciences
- Data from California Department of Forestry (CDF) biological and hydrological assessments of THPs (Valentine et al. 1995a, 1995b, 1995c)
- Various other published and unpublished reports of studies conducted in JDSF assessment area streams (e.g., Knopp 1993; Botorff and Knight 1996; Valentine and Jameson 1994)
- Proceedings of the Conference on Coastal Watersheds: the Caspar Creek Story (Ziemer 1998).

Habitat conditions in JDSF streams are summarized in Table I and Figure I. Values reported represent the means of measurements taken in survey reaches located in each of four Montgomery and Buffington (1993) gradient categories.

Channel Confinement and Refuge Habitat

Confinement classifications were made for all Class I stream channels for which aerial photographic coverage was available. Confined channels make up 97 percent (184 mi or 296 km) of the classified Class I stream length in the JDSF assessment area. Field verification of channel confinement assessed from aerial photographs confirmed the agreement between remotely assessed delineation and field delineation in 16 of the 17 survey reaches. In nine of the 15 Planning Watersheds (PW) in the assessment area, confined channels account for 100 percent of the classified Class I stream length. The Two Log Creek PW contains the most non-confined stream mileage (2.8 mi or 1.7 km). Incised channels, even where the stream is not confined within the valley bottom, have little or no connectivity between channels and floodplains, and typically provide very little off-channel or side-channel habitat that would furnish low-velocity refuge during high flow events. Although valley confinement is not subject to the influences of land management and watershed disturbances, the degree of channel incision is highly dependent on changes in sediment supply that potentially result from such activities. Refuge habitat is the portion of the active channel that potentially provides areas of low water velocity during high flows, thereby serving as valuable over-wintering habitat. In streams in the assessment area, refuge habitat consists primarily of alcoves along the channel

margin and backwater areas. Reaches in the 0–1 percent gradient range have the lowest overall percentage of this habitat, with just over 1 percent of the total area classified as alcoves or backwaters (see Table I). This type of refuge habitat did not differ appreciably among the remaining three gradient categories. Substantial amounts of off-channel or side-channel habitat were not observed during the 1997 stream channel surveys. These features may exist elsewhere in the JDSF assessment area, but they are expected to be infrequent because of the confined nature of most JDSF streams.

TABLE I
AQUATIC HABITAT CONDITIONS IN JDSF STREAMS, MEASURED DURING SUMMER 1997 BY STILLWATER SCIENCES
(Except V* from Knopp [1993])

Channel Gradient	Habitat Parameter (mean values)							
	Pool Spacing [b]	Pool Area (%)	Average Maximum Pool Depth (m)	V*[a]	Key LWD Spacing [b]	Reach-level d50[c] (mm)	Spawning Gravel d50 (mm)	Alcove/ Backwater Habitat (%)
0–1%	6.1	25.4	0.76	no data	8.9	48	24	1.1
1–2%	5.2	29.3	0.84	0.28	7.6	55	27	2.2
2–4%	10.5	14.3	0.62	0.39	4.2	49	20	2.0
4–8%	9.1	17.2	0.69	no data	4.5	50	19	2.0

a) From Knopp (1993)
b) Bankfull channel widths between pools or key pieces
c) Total (non-structure) bed substrate grain size

Pool Habitat

Channels with the lowest gradients were found to have the lowest pool spacing and the highest percentage of pool surface area (Table I and Figure I). Pool spacing, reported as the average distance between pools (measured in bankfull channel widths) was lowest in the 1–2 percent gradient reaches (5.2 bankfull channel widths between pools) and highest in 2–4 percent gradient reaches (10.5 bankfull channel widths between pools). Average pool spacing observed in 0–1 percent and 1–2 percent channels falls within the range of properly functioning conditions for pool habitat (NMFS and USFWS 1997) for channels of similar width and gradient. In steeper channels surveyed in JDSF, however, average pool spacing is below the NMFS and USFWS (1997) criteria for properly functioning conditions in these channel types.

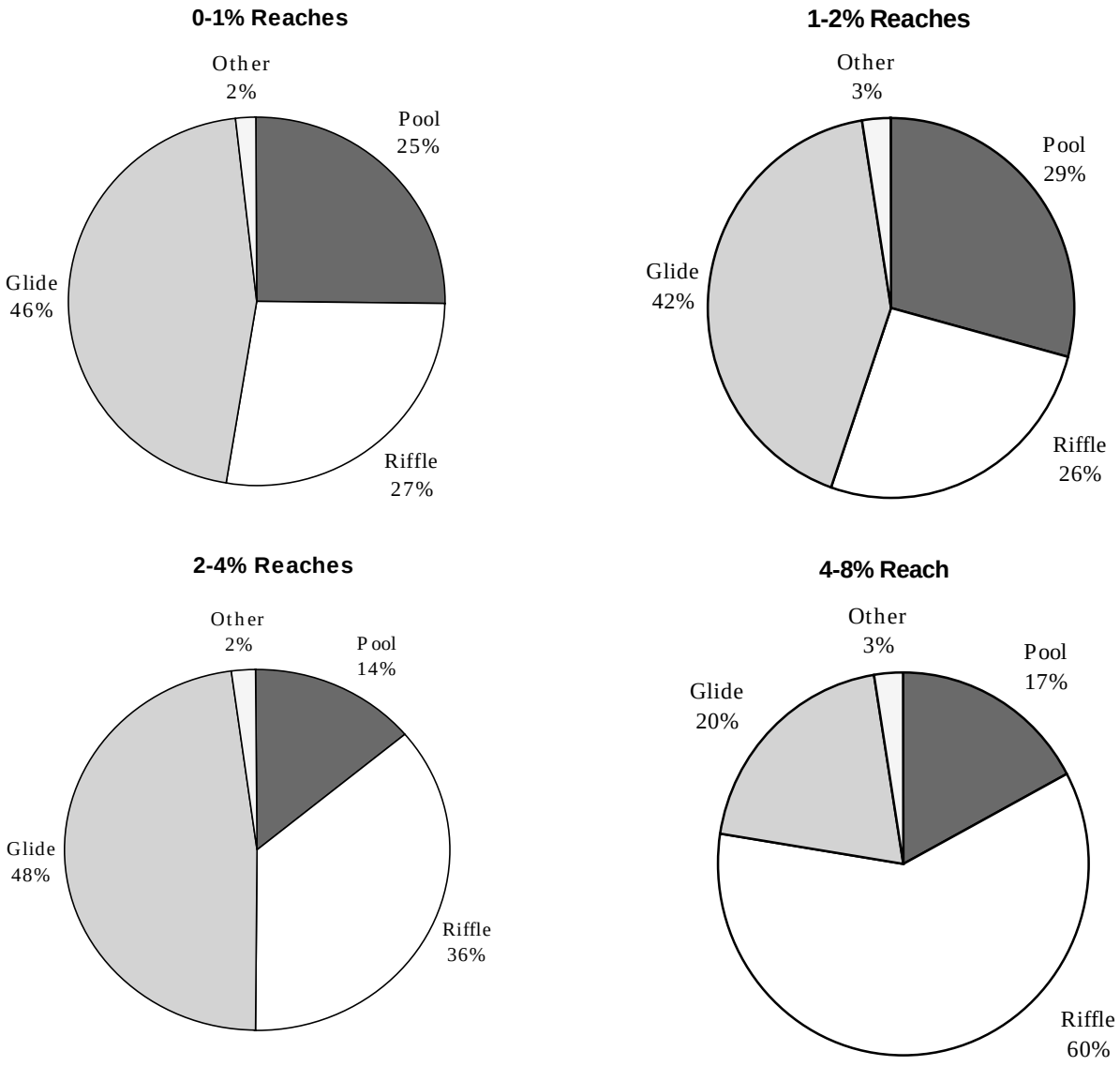

FIGURE I
Habitat type frequency, by gradient category, for JDSF streams surveyed by Stillwater Sciences, 1997

In addition to having lower pool spacing than any of the other four gradient categories, 1-2 percent gradient reaches also have the highest average percentage of pool surface area—29.3 percent (see Table I). The lowest average percentage of pool area (14.3 percent) occurred in 2–4 percent gradient reaches, which is consistent with the pattern seen for pool spacing. Average JDSF pool surface area in the two lowest gradient channel types (0–1 percent and 1–2 percent) meets the NMFS and USFWS (1997) criteria for properly functioning condition, but in the steeper channel types is below the NMFS criterion. As shown in Figure I, the proportion of pool, riffle, and glide habitats was found to be similar in reaches of less than 2 percent gradient. In 2–4 percent gradient reaches, pool area occupied only 14 percent, with both riffle and glide areas increasing relative to the lower gradient reaches.

Knopp (1993) measured the degree to which pools in channels with gradients less than 3 percent (in the 1–2 percent and 2–4 percent Montgomery-Buffington gradient ranges) were filled with fine sediments in several survey reaches within the JDSF assessment area. Values of the V* index, which is an expression of the average ratio of the volume of fine sediment to the residual pool volume (Lisle and Hilton 1991, 1992), averaged 0.28 for 1 –2 percent channels, and 0.39 for 2–4 percent channels (Knopp 1993; and Table I). V* values in this range appear to be characteristic of watersheds in northern coastal California with similar management histories (Knopp 1993). Lisle and Napolitano (1998) reported V* values in the North Fork Caspar Creek generally ranged from 0.16 to 0.33 over a seven year period between 1991 and 1997. V* for the same period in the South Fork Caspar Creek ranged from 0.12 to 0.27.

Lisle and Hilton (1999) stated values of V* greater than 0.2 (20 percent pool filling) are characterized by large patches of fines sediment occupying much of the area of pools; fine patches being evident elsewhere and surface interstices noticeably filled. V* values less than 0.1 (10 percent pool filling) are reflected in fine bed material in pools being confined to small discontinuous deposits in eddies and not evident among surface interstices (Lisle and Hilton 1999). However, Lisle and Hilton (1993) stated care should be taken in interpreting differences in V* between different stream channels. For example, a V* value of 0.15 would be expected to represent high sediment supplies in basins underlain by competent metamorphic rock, but would be considered low for basins in weathered granite (Hilton and Lisle1993). V* values can be temporarily high in pools downstream of substantial sources of sediment such as landslides or stream crossing failures. Conversely, low V* values may be the result of recent bed scour and sediment transport, possibly caused by high flow events. Because Knopp's (1993) data were collected in 1992, following 5 to 7 years of low flow conditions with few large peak discharge events, the results may represent habitat conditions resulting from below-normal flows.

Spawning Gravel Quality

The quality of spawning gravel is influenced by several factors affecting the success of spawning salmonids and the survival of incubating eggs and emerging fry. These factors include the size of the gravel, the size and location of available spawning areas, the proportion of fine sediment in the gravel at the time of spawning, and subsequent deposition of fine sediment in the redd during incubation and development (Beschta and Jackson 1979; Grost et al. 1991; Peterson et al. 1992). Too much fine sediment can fill gravel interstitial spaces affecting the ability of salmonids to construct redds; thus, restricting intragravel water flow, retarding incubation of eggs, and impeding fry emergence (Furniss et al. 1991; Spence et al. 1996).

Class I stream channels within the JDSF assessment area are generally gravel-bedded (CDFG 1995b, 1996b, 1999). Cobble is the second most frequent dominant bed surface substrate. Sand and smaller sediments are generally the dominant surface bed substrates only in the low-gradient lower reaches of the Big River and Caspar Creek (CDFG 1995b and 1996b). Coarse bed substrates can provide valuable cover and thereby contribute to the rearing success of juvenile salmonids. Newly emerged fry can occupy the voids of substrate made up of 2-5 cm diameter rocks, but larger fish need cobble and boulder-size (>7.5 cm) substrates (Bjornn and Reiser 1991). The estimated reach-level geometric mean diameter (d50) of bed substrates in JDSF streams was lowest in 0–1 percent gradient channels (48 mm), and highest in 1–2 percent gradient channels (55 mm), although

substantial differences between the four gradient categories were not observed. These d50 estimates relate to the mobile fraction of the bed substrate, and do not take into account the fluvially immobile framework particles that are present (but not dominant) in some of the higher gradient channels.

The geometric mean particle size (d50) of spawning gravels measured at pool tailouts in JDSF streams during the summer of 1997 ranged from an average of 19 mm (3/4 inch) in 4-8 percent gradient channels, to an average of 27 mm (1 inch) for channels in the 1–2 percent gradient range (see Table I). These values are well within the range of suitable gravel size for both coho and steelhead spawning (Bjornn and Reiser 1991).

The embeddedness of spawning gravels has generally been used as a general indicator of interstitial conditions (space and flow) and the amount of fine sediment present in the gravel. Valentine et al. (1995a, 1995b) measured cobble/gravel embeddedness at pool tailouts in several JDSF streams as part of the biological and hydrological assessments of proposed THPs. All of the reaches surveyed had gradients of less than 3 percent. Embeddedness in the Little North Fork Big River and the South Fork Noyo River averaged about 50 percent, which was considered moderate. Slight to moderate embeddedness was also reported for survey reaches in Hare Creek and Bunker Gulch, although percentage embeddedness values were not reported for these streams (Valentine et al., 1995c). The CDFG (1995, 1996, 1997, 1999) estimated embeddedness in surveyed 30 watercourses in JDSF. Of the 4013 pooltails surveyed 9% had a value of 1 (0-25% embedded), 29% had a value of 2 (26-50%), 32% had a value of 3 (51-75%), 13% had a value of 4 (75-100%), and 18% had a value of 5 (cemented). Substrate with an embeddedness value of 1 is considered good quality for salmon and steelhead spawning.

The average percentage embeddedness of spawning gravels at pool tailouts in JDSF stream reaches surveyed by Stillwater Sciences in 1997 was lowest in the 4–8 percent gradient channels (18 percent embeddedness) and highest in the 2–4 percent gradient channels (32 percent embeddedness). Average spawning gravel embeddedness in the 0–1 percent and 1-2 percent gradient survey reaches was 20 percent and 27 percent, respectively. Possible reasons for the discrepancy between these values and those reported by Valentine et al. (1995a, 1995b) may include differences in sampling methodology and local differences in sediment supply, storage, and transport processes. Further research is required to establish the biological significance of embeddedness to salmonids (Peterson et al., 1992).

Burns (1970, 1971, 1972) conducted salmonid habitat investigations in northern California before, during, and after logging in several watersheds in the late 1960's. Valentine and Jameson (1994) replicated portions of Burns' work on the Little North Fork Noyo River. Burns' studies found mean stream width increased from 1.5 to 2.3 m. and average depth decreased from 15 cm. to 9 cm. as a result of logging and road building. Valentine and Jameson found stream depth had recovered, if not increased, to 21 cm. and width was intermediate (2.1 cm.) between Burns' pre- and post-logging period. Burns (1970) found mean percentage of fine sediment (<0.85 mm) in spawning substrates increased from 20 to 33% as a result of harvest activities. Valentine and Jameson's (1994) percentage of fine sediment in spawning substrate was intermediate (25.4%) to Burns' pre- and post-logging period. Additional sampling was conducted by Valentine in 1991 and 1993 at other Little North Fork sites and had an average percent fines of 21.5 and 15.8, respectively. Burns (1970) reported sediment <3.3 mm in size made up an average 43.3% of the substrate following logging in 1968 and 1969. Valentine and Jameson (1994) reported an average 33.7% of the substrate was <3.3 mm.

Burns (1972) found that the percentage of fine sediment smaller than 0.8mm in the South Fork Caspar Creek substrate increased from 20.6% to 34.2% immediately after road construction. Twenty-two months later this class of sediment was 28.5% of the substrate composition. Valentine (2002) revisited the Burns (1972) reach in the South Fork. Valentine (2002) found sediment smaller than 0.85mm made up approximately 27% of the substrate composition.

Riparian/LWD Loading

Riparian areas form a critical link between the terrestrial and aquatic environments, exerting a strong influence on the biological and physical processes that create and maintain aquatic habitats. Riparian vegetation contributes large woody debris (LWD) which help create pools and route sediment; provides shade that moderates stream water temperatures; influences aquatic and terrestrial food webs by contributing organic matter and nutrients to streams; helps stabilize stream banks, maintains channel bed form, stores sediment; and provides important habitat for a variety of plants and animals. These zones are also among the first to exhibit the effects of improper management and a departure from the production of desired values. Timber harvesting has the potential to alter stand characteristics within and adjacent to the riparian zone, which in turn affect physical and biological processes in the aquatic environment.

When a tree falls in a forest, the probability of its falling into a stream is primarily a function of tree height and distance from the stream (Robison and Beschta 1990). The probability that a tree falling in the riparian zone will enter a watercourse is inversely proportional to its distance from the creek. O'Conner and Ziemer (1989) also found that bank erosion accounted for approximately 45% of the source identifiable LWD with windthrow accounting for about 17%. Murphy and Koski (1989) determined these processes accounted for 73% of all inventoried LWD in their unentered old-growth study site with tree mortality accounting for 23% and landslides 4%. In general, the primary zone of input is equivalent to the height of the tallest tree growing along the stream (Fetherston et al. 1995) although the proportion of trees entering a watercourse decreases as distance from the channel increases. Reid and Hilton (1998) reported that about 90% of the instances of debris input occurred from falls within 115 feet of the channel in un-reentered forests and within 164 feet of the channel in buffer strips. However, for trees entering the channel from the outside portion of the input zone, the upper crown of the tree does not normally have wood of sufficient size to be considered coarse woody debris. For instance, a 180-foot tall tree (100 year old tree on Site Class II ground) on the outside of a 150-foot wide WLPZ falling directly toward a watercourse would have only the top 30 feet inside the channel. This treetop would provide little or no value to the stream or fish habitat. Thus, an "effective tree height," which is the height to the minimum diameter and length necessary for wood to qualify as coarse woody debris would be a more appropriate standard to use for assessing the potential fall area (Robison and Beschta 1990).

A 12-inch diameter piece of LWD could function to form pools in a 10-foot wide channel (Bilby and Ward 1998). A log 27 feet long with a 16-inch midpoint diameter is the recommended size for a key piece of LWD in a 15-foot wide channel (Fox 1994 *in* WDNR 1997). These diameters could be considered the minimum functional size for LWD in the JDSF. If one were to take tree taper into account, the 12-inch midpoint on a recruitable log may be achieved with an upper stem diameter of approximately 8 inches. That would leave the top of the tree (approximately 30-40 feet in length above the 8-inch diameter) with little significant hydraulic function shouldit enter the creek. Even

though a 12-inch diameter log may be functional in a relatively narrow stream, larger pieces of LWD are needed to provide greater stability and benefits to aquatic biota in higher order watercourses.

LWD recruitment to watercourses is also dependent on retaining an adequate number of trees following harvesting operations. As stated above 90% of LWD inputs occur from within 115 feet of the channel in un-reentered second growth in the North Fork Caspar Creek (Reid and Hilton 1998). Reid and Hilton (1998) reported a background fall rate of 0.12% or 0.4 trees per hectare per year in Caspar Creek. Reid and Hilton (1998) also observed an increase in average annual fall rates to 1.9 $\pm$ 0.7% or 3 to 7 trees per year per hectare for buffer strips due to windthrow influences. O'Conner and Ziemer (1989) found that windthrow accounted for approximately 17% of the source identifiable LWD in North Fork Caspar Creek. Buffer fall rates can be expected to decrease as more susceptible trees fall and the remaining became wind firm. Lisle and Napolitano (1998) reported a significant increase in bed material storage and pool number and volume, and fine sediment storage following logging due to blowdown of riparian trees. Approximately 1,000 Mg of sediment accumulated in the channel, but this was most likely due not to an oversupply of sediment, but from an increase in storage potential created by a 50% increase in woody debris volume in the lower 600m of the channel (Lisle 1998). The new wood came from extensive windthrow from a buffer strip that was left from logging (Reid and Hilton 1998). The increase in wood (along with the increased sediment storage) resulted in a doubling of pool volume (Lisle 1998). Although this was considered a short-term benefit, the long-term outlook was predicted to be a loss of sediment storage, pool volume, and habitat complexity in reaches bordered by clearcuts and buffer strips (Lisle and Napolitano 1998). Lisle and Napolitano (1998) attributed this prognosis to decay in existing LWD loads and decreased inputs from depleted riparian sources.

Debris loading generally decreases in the downstream directions as channel width and drainage area increases (Keller et al. 1995). As channel width increases downstream, an increasing proportion of all wood becomes mobile (Bilby and Ward 1989). Farther downstream even the largest debris may be floated away (Keller et al. 1995). Conversely, Bilby and Ward (1989) found progressively smaller pieces of debris and thus a higher proportion of the wood input remained in the channel as stream size decreased. Benda and Sias (1998) reported transport of wood by stream flow depends on piece length, and, in general, highly mobile pieces shorter than the width of the channel at bankfull. Floated debris, especially in smaller streams, usually does not travel far before it is stranded on streambanks at high flow levels or against obstructions in the channel (Swanson et al. 1976). Benda and Sias (1998) suggested that piece length needs to be shorter than the bankfull width for significant LWD transport to take place. Benda and Sias (1998) said that since first and second order channels can comprise 80% of the channel network, significant wood transport by fluvial processes may be limited to approximately 20% of the channel length in a watershed.

Keller et al. (1995) determined that minimum residence times for LWD in Little Lost Man and Prairie Creeks, Redwood National Park. They found that residence time in the channel varied from 20 to more than 200 years. About 70% of the LWD was in residence 75 years and about half were stable for more than 100 years (Keller et al. 1995). Andrus et al. (1998) determined that trees must grow beyond 50 years before riparian stands yield LWD in quantities similar to old-growth forests. McHenry et al. (1997) concluded inputs of LWD from stands less than 73 years old were of insufficient size to be stable in a channel. Grette (1985) *in* Bisson et al. (1987) showed inputs of

second-growth conifer debris did not significantly increase until approximately 60 years after timber harvest. Based on these studies, trees replacing windthrow may not become recruitable to streams until 50-73 years following the blowdown event.

Keller et al. (1995) determined that approximately 64% of the variability of LWD loading may be explained by the variability in the number of mature redwood trees per hectare within 50 m of the streambanks. The remaining 36% was presumed to be associated with local geologic and biogeographic conditions (Keller et al. 1995). Keller et al. (1995) found instream wood loads in Redwood National Park were proportionate to the number of trees within 50m of the channel. Keller et al. (1995) concluded debris loads ranging from 0.02 to 0.6 m^3 per meter of channel were proportional to 20 to 100 mature trees per hectare (~2.5 acres). Much of the Class I and II WLPZ acreage on JDSF is dominated by stands of large conifers. Approximately 63% of the 7,753 acres is made up of WHR (Mayer and Laudenslayer 1988) 5 or 6 size classes (>24 inches dbh). Although some of these trees may experience blowdown within 5 to 7 years following harvesting operations, the majority will remain standing and continue to supply long-term inputs of LWD to the channels. Shade tolerant conifers (hemlock, grand fir) will likely become established in the openings created by the windthrow. These trees will likely begin supplying instream LWD within 50 to 75 years following their establishment. Therefore, the initial increase in instream wood volumes, debris residence times, retention of large trees capable of supplying LWD, and ingrowth growing rates may limit significant adverse impacts to instream habitat from adjacent harvesting operations or WLPZ thinning. In addition, the use of selection harvesting over the majority of the JDSF may limit blowdown in those areas.

Oliver et al. (1994) found that young-growth redwood responded well to thinning in each of the three treatment areas during the 15-year study period. Oliver et al. (1994) reported stands thinned at 25% of initial density (75% retained) increased annual diameter growth by 30-37% (0.19-0.24 inches DBH/yr.) as compared to the untreated stand (0.12-0.17 inches DBH/yr.). The stands thinned to 50% initial density increased annual diameter growth 40-43% (0.3-0.4 inches DBH/yr.) as compared to the untreated stands. Henry (1999) reported results from a study that analyzed growth response of five treated (densities 100-300 trees per acre) and one control (700 t.p.a.) third growth redwood stands from 1981 to 1998. Trees >10.5 inches in the 100 and 150 stems per acre treatments grew an average of 20.35 inches in diameter (1.69 in./yr.) between 1981 and 1998 whereas the 300 t.p.a. stand grew 16.5 inches (1.38 in./yr.) and the uncut stand grew 14.9 inches (1.24 in./yr.) in the same period (Henry 1999).

The Scientific Review Panel (Ligon et al. 1999) stated "There are many other considerations for management of the riparian zone, but it appears that thinning, if properly applied (while giving equal consideration to other functions of the riparian zone), can increase tree growth in a manner that is compatible with the objectives of achieving properly functioning habitat conditions. However, this must be combined with the near-term retention of larger diameter trees and treatment of the WLPZ to increase recolonization and regrowth of conifers. These combined efforts will provide the best opportunity to ensure long-term recruitment of LWD." In addition, while permanent retention of large trees could insure future LWD recruitment, retaining trees that have a greater likelihood of being recruited to streams may protect relatively near-term inputs. These include those that lean toward the stream, are on unstable slopes or banks, or contain rot.

Keller et al. (1982) reported the equivalent of one key piece of LWD per 1.8 to 2.5 channel widths in confined, low- to mid-order streams draining old-growth redwood forests in Redwood National Park, in coastal Humboldt County, California. In JDSF streams with the same general physical characteristics, LWD frequency in 1997 averaged one key piece per 6.9 channel widths (range: one key piece per 2.1 to 23.1 channel widths; Table I). The average density of all LWD in the Redwood National Park streams was 0.136 cubic meters of LWD per square meter of active channel at sites with drainage areas of the same order of magnitude as the North Fork Caspar Creek watershed (Keller and MacDonald, 1983). In the same study, the authors reported LWD densities of 0.042 and 0.048 cubic meters per square meter at sites on upper and lower North Fork Caspar Creek, respectively. O'Connor and Ziemer (1989) found a LWD density of 0.017 cubic meters per square meter in an area they define as the "effective zone" (roughly equivalent to the active channel) in their study reaches on North Fork Caspar Creek. This apparent discrepancy may be the result of local variability in LWD densities. The value reported by O'Connor and Ziemer (1989) may better represent the average for North Fork Caspar Creek, because their contiguous survey reaches encompassed a larger area of the channel than did the area surveyed by Keller and MacDonald (1983).

Napolitano (1998) reported a LWD density in North Fork Caspar Creek of 24 kilograms per square meter and densities in physically similar streams in old-growth redwood basins of 49-268 kilograms per square meter. Napolitano (1998) suggests that LWD loading in North Fork Caspar Creek was greatly diminished by historical logging activities and changes to second-growth cover. As these comparisons demonstrate, it is apparent that LWD loading in North Fork Caspar Creek is considerably lower than in streams of remnant old-growth redwood forests in coastal northern California. It should be recognized, however, that local variability in LWD loading can also be influenced by differences in geomorphology, climatic variations, past management, and stochastic natural events (such as episodic windthrow of trees in the riparian zone).

The apparent absence of LWD removal projects in (post-1940s) North Fork Caspar Creek stands in contrast to that which occurred in the past in many other JDSF streams [See Figure B (LWD Removal and Stream Clearing Projects Map) in the Figures Section]. The most recent documented removal of LWD and other obstructions from the channel of North Fork Caspar Creek took place during old-growth logging from 1864 to 1904, when splash dams were used to transport logs downstream to the mill (Napolitano 1998). The South Fork Caspar Creek was cleared of LWD when the road was built in 1967. There was extensive debris removal after logging, with a tractor used in the channel expressly for this purpose (Burns 1972).

Large woody debris loading in several other JDSF stream reaches was also reported in biological and hydrological assessments of THPs (Valentine et al. 1995a, 1995b, 1995c), and watershed cumulative impacts assessments of THPs. The density of LWD in Hare Creek was approximately 0.029 cubic meters per square meter of high flow channel, and was twice that amount (0.058 m^3/m^2 of high flow channel) in Bunker Gulch, a tributary to Hare Creek (Valentine et al. 1995c). Removal of LWD is known to have occurred in Bunker Gulch and portions of Hare Creek in the 1980s. The Hare Creek drainage may have also been subject to undocumented LWD removal as part of stream clearance efforts in the 1970s and old-growth logging around 1900 (Valentine et al. 1995c).

Valentine et al. (1995a, 1995b) and CDF (1996) collected additional LWD loading data in the Little North Fork Big River, the South Fork Noyo River, and several South Fork Noyo tributaries. Although these data were recorded as volume (m^3) of LWD per 1,000 ft of channel length, and are

therefore not comparable to the LWD loading values reported above, they do allow comparisons among several JDSF watersheds. Loading was highest in the Little North Fork Big River (7,675-m3/1000 ft), where only scattered LWD removal in the 1980s and early 1990s has been documented. Past LWD removal activity in the Little North Fork Big River is also noted by Valentine et al. (1995a), but additional details of the extent or how long ago LWD was removed from this stream, which would supplement the information presented, are not available. In the South Fork Noyo River drainage, LWD loading ranged from a high of 2,394 cubic meters per 1,000 feet in Peterson Gulch (a small tributary to the South Fork Noyo River, near the CDFG egg-taking station) to a low of 124 cubic meters per 1,000 ft in mainstem South Fork Noyo River (Valentine et al. 1995b). Removal of LWD along most of mainstem South Fork Noyo River is documented to have occurred in the 1950s, 1980s, and 1990s as part of stream clearance projects, but no removal activity from Peterson Gulch is known. High LWD loading in Peterson Gulch is thought to be related to construction of a rail line there during old-growth logging (Valentine et al. 1995b). Although old-growth logging has potentially influenced long-term LWD recruitment rates to these channels, the absence of known splash dams in this area leads to the supposition that the channel was not cleared of LWD during historical logging operations.

Water Temperature

Water temperature is an important habitat parameter potentially influencing reproductive success and survival during all freshwater life stages for coho salmon, steelhead, and many amphibians, aquatic macroinvertebrates, and other organisms (Bjornn and Reiser 1991). Water temperature influences metabolism, behavior, and mortality of fish and other organisms in their environment. Coho salmon tend to be relatively intolerant of elevated summer water temperatures and may therefore be absent from streams that contain steelhead. Although fish may survive at temperatures near the extremes of the suitable range, growth is reduced at low temperatures – because all metabolic processes are slowed – and at high temperatures – because most or all food must be used for maintenance (Bjornn and Reiser 1991).

Water temperatures generally increase in a downstream direction even in fully shaded streams (Sullivan et al. 1990). As streams become progressively larger and wider, riparian vegetation shades a progressively smaller proportion of the water surface (Beschta et al. 1987; Spence et al. 1996; Murphy and Meehan 1991). In small- to intermediate-sized streams of forested regions, incoming solar radiation represents the dominant form of energy input to streams in the summer. Removal of a stream's riparian canopy typically increases solar radiation intensity, summer water temperature and diurnal temperature fluctuations throughout the year (Chamberlin et al. 1991; Hetrick et al. 1998). Removal of too much canopy can adversely affect growth and survival of rearing salmonids. Spence et al. (1996) concluded buffer widths of approximately 0.75 site-potential tree heights are needed to provide full protection of stream shading. FEMAT (1993) reported that nearly all shade to a stream can be maintained by a buffer width equal to approximately 0.8 potential tree height. A 100-year old site potential tree is approximately 170 feet high growing on Site Class II ground. Therefore, if FEMAT (1993) is correct, a buffer of approximately 136 feet wide should provide nearly all the shade canopy of an unentered forest. However, riparian vegetation also limits light penetration to a stream and may suppress aquatic primary productivity (Murphy and Meehan 1991).

Overstream canopy densities are generally considered to be high throughout JDSF. Of the 35 stream surveys conducted by CDFG between 1995 and 1997, 25 streams had densities exceeding 90%, 6 streams exceeded 80%, and 4 streams were between 60 and 79%. These canopy densities developed under the FPRs and 1983 management plan. See Figure E (Canopy Cover Map) in Figures Section.

Planned openings along cold, closed canopy coastal streams could improve periphyton production leading to increased aquatic invertebrate abundance and subsequently enhance fish productivity, if other habitat requirements were maintained (Murphy and Meehan 1991; Chamberlin et al. 1991; Hetrick et al. 1998). Hetrick et al. (1998) reported increases in water temperatures due to canopy removal along 40-70 meter sections of streams with subsequent decreases in temperatures as the stream flowed through undisturbed reaches of the same length. However, cumulative effects of increased water temperature and sediment from numerous disturbances in a watershed can nullify any beneficial effects of increased food production (Murphy and Meehan 1991). Therefore, timber-harvesting activities in riparian zones need to be carefully planned if improved salmonid production is desired.

Water temperature suitability for anadromous salmonids in the North Coast Region can be evaluated using the maximum weekly average temperature (MWAT) approach. The MWAT threshold is a measure of the upper temperature recommended for a specific life stage of freshwater fish (Armour 1991). For coho salmon and steelhead, the MWAT threshold is calculated for the late-summer rearing life stage, because water temperatures are generally highest during this stage. Welsh et al. (2001) found coho present in streams with MWATs up to 16.7°C (62°F). Welsh et al. (2001) also found coho in all stream where MWATs were less than 16.3°C (61°F). Coho salmon are considered to be less tolerant of high water temperatures than steelhead. The JDSF has been gathering water temperature data since at least 1965 to help determine the potential impacts of timber management activities on fisheries resources.

Cafferata (1990) reported pre-management water temperatures in the North Fork and South Fork Caspar Creeks. Most observed summer maximum stream temperatures in 1965 were slightly below 16°C (60°F) with absolute maximums reaching 17°C (62.6°F) at the weirs. In 1988, small totally uncut tributary basins had maximum temperatures of about 13°C (56°F) with average daily highs about 12°C (54°F).

The maximum values for weekly average temperatures (calculated as 7-day running means) from 1996 summer water temperature monitoring sites in JDSF ranged from 12.6°C (54.7°F) to 18.9°C (66.0°F) (Valentine 1997). Maximum 7-day averages in summer 1997 ranged from a low of 14.1°C (57.4°F) to a high of 18.7°C (65.7°F) (Valentine 1998). Maximum 7-day averages in summer 2000 ranged from a low of 13°C (55°F) to a high of 17.3°C (63°F) (Valentine 2000). Seven-day average temperatures exceeded the Welsh et al. (2001) criterion of 16.7°C (62°F) for juvenile coho salmon on at least one occasion at eight locations within the assessment area during summer 1996, and eight locations during summer 1997. Seven of the eight locations where the Welsh et al. (2001) threshold was exceeded during summer 1996 are on the North Fork Big River. The other location at which the Welsh et al. (2001) threshold was surpassed was on the South Fork Noyo River, near the Parlin Fork Conservation Camp. In 1997, three of the locations where the threshold was surpassed were on the South Fork Noyo River and three were on the North Fork Big River. Of the remaining two locations in 1997, one was on Parlin Creek, a tributary of the South Fork Noyo River, and one was on Chamberlain Creek, a tributary of the North Fork Big River. In 2000, the two locations where the

threshold was surpassed were on the South Fork Noyo near the Parlin Fork Conservation Camp and downstream of Bear Gulch. In 1996, all of the highest 7-day average temperature values occurred during July. In 1997, four of the highest 7-day average temperatures occurred in September, three in July, and one in August. In 2000, eleven of the highest 7-day average temperatures occurred in July, with one in August and one in September. Four of the eight sites where the threshold was exceeded during summer 1996 also exceeded 18° C (64 °F). Each of these four sites is located on the North Fork Big River.

Geomorphology

The mechanisms for channel change are affected by altered inputs of water, sediment, and woody debris that originate from hillslopes, headwater channels, and riparian areas that were disturbed by recent logging (Lisle and Napolitano 1998). Forest harvesting directly affects these processes when it increases (or decreases) the supply of sediment, alters the peak flow or the frequency of high flows, and when it changes the structure of the channel by removing the supply of large woody debris that forms sediment storage sites (Meehan 1982 in Chamberlin et al. 1991). Substantial increases in peak flows or the frequency of channel-modifying flows can increase bed scour or accelerate bank erosion. Substantial increases in sediment supply from mass movements or surface erosion, bank destabilization, or instream gravel storage losses can cause aggradation, pool filling, and a reduction in gravel quality. Loss of stable instream woody debris by direct removal, debris torrents, or gradual attrition as streamside forests are converted to managed stands of smaller trees will contribute to loss of sediment storage sites, fewer and shallower scour pools, and less effective cover for rearing fish (Chamberlin et al. 1991).

Sediment entering streams is delivered chiefly by mass movement or surface erosion processes (Swanston 1991). Forest practices can substantially increase delivery of sediments to streams through these processes (Spence et al. 1996). The effect of forest practices on sediment transport depends on a number of local site conditions including climate, vegetation, topography, and soil type as well as on specific aspects of the activity, including the type and areal extent of disturbance and the proximity of the disturbance to the stream channel (Spence et al. 1996). Thus, the relative effects of road building, timber harvest, and other forest practices on sediment production vary with location (Spence et al. 1996).

Cafferata and Spitler (1998) conducted a comparative analysis of logging impacts in the North and South Forks of Caspar Creek from harvesting and road building operations that were conducted prior to and following introduction of the modern FPR. Roads (4.2 miles) were built throughout the entire South Fork Caspar Creek watershed in 1967 with many built low on the slope, adjacent to or in channels. The watershed was selectively logged with crawler tractors between 1971 and 1973. Approximately 48% of the North Fork was clearcut from 1985 to 1992 using 7.1 miles of existing road and 5.2 miles of new road located high on ridges. Approximately 80% of the North Fork was cable yarded. The South Fork showed a 212% increase in suspended sediment loads over background levels. The North Fork showed an 89% increase in suspended sediment load over background. The volume of sediment discharged by landslides (>100 yd^3) from the uncut and clearcut units to date (1998) was approximately the same: 11 yd^3/ac. from the uncut units and 10 yd^3/ac. from the harvested areas (Cafferata and Spitler 1998). Cafferata and Spitler (1998) concluded the road, landing, and skid trail design, placement, and construction are the dominant controls on the number and locations of shallow landslides.

Significant impact to form and function of stream channels located within JDSF boundaries has resulted from the widespread removal of LWD from low gradient (0-4 percent) stream channels from the 1950's to the early 1990's, splash damming, and riparian timber harvest (Figure B in Figures Section). These activities reduced pool frequency and depths (Napolitano 1998), and overall habitat complexity, which have in turn reduced the quality of over-summering and over-wintering habitat for anadromous fishes. Where wood has been removed, stored sediments have flushed, resulting in channel lowering and entrenchment – disconnecting channels from floodplains and reducing backwater habitats – thought to be important refuges for fish during strong winter storms. .

See the Pool Habitat, Spawning Gravel Quality, and Riparian/LWD sections for additional information.

Nutrients

Nutrient inputs to watercourses from riparian zones are critical in maintaining aquatic productivity. Spence et al. (1996) concluded buffer widths of approximately 0.75 site-potential tree heights are needed to provide full protection for nutrient inputs. Timber harvesting in riparian zones has the potential to affect nutrient cycling. Dahlgren (1998) studied the effects of forest harvesting on nitrogen cycling in the Caspar Creek watershed. He reported that in contrast to other forest ecosystems that show large nutrient losses in stream water after harvest, this Douglas fir/redwood ecosystem shows relatively small losses. Dahlgren (1998) concluded, "Clearcut harvesting in this Douglas fir/redwood ecosystem did not result in any short-term detectable decrease in soil carbon and nitrogen pools. Stream-water nitrate concentrations were increased after clearcutting, especially during storm events with high stream discharge volumes; however, fluxes in stream water were relatively low compared to results from other forest ecosystems. Immobilization of nutrients by the rapid regrowth of redwood stump sprouts appears to make this ecosystem relatively resistant to nutrient loss by leaching after harvest. The elevated nitrate concentration in streams draining clearcut watersheds was substantially decreased at downstream sampling points. By the time the stream left the experimental watershed, nitrate concentrations were near those of the nonperturbed reference watersheds. Removal of nitrogen in the harvested biomass results in an appreciable loss of nitrogen from the forest ecosystem. These data suggest that nitrogen fixation by Ceanothus may be an important nitrogen input that is necessary to maintain the long-term productivity and sustainability of these ecosystems."

2. SPECIAL STATUS FISH SPECIES

Both coho salmon and steelhead are of particular ecological and economic importance in coastal California, and both have undergone well-documented declines in overall abundance. The Central California Coast coho salmon, which includes populations within the assessment area, was listed as a threatened species under the federal Endangered Species Act (ESA) in 1996 (NMFS 1996). Northern California steelhead, which includes populations within the assessment area, was listed as a threatened under the ESA in 2000 (Federal Register Vol. 65, No. 110, June 7, 2000).

Life history and habitat requirements of the special-status fish species (i.e., coho salmon and steelhead) are discussed below. Streams in the assessment area also support amphibians and other aquatic and riparian species in addition to fish.

Fish Distribution

Historically, coho salmon and steelhead occurred in all of the PWs in the JDSF assessment area. The upstream extent of fish can vary annually and seasonally depending on environmental variables such as precipitation, water temperature, and flow. Fish distribution can also be influenced by changes in channel morphology caused by high flows, landslides, or other stochastic events that limit habitat accessibility and suitability.

In summer and fall of 1995, 1996, and 1997 streams in the assessment area were surveyed by CDFG crews under contract with CDF to identify the upstream extent of salmonids and document the species present (CDFG 1995, 1996). In most of their surveys, CDFG crews identified potential barriers to salmonid migration and ended stream inventories at barriers or where stream flows were deemed too low to provide suitable salmonid habitat. Distribution data collected using this methodology should be considered to be conservative low flow estimates, since the upstream extent of salmonid distribution can be greater during higher (i.e., winter) flow conditions. No fish abundance data were collected during these surveys. Other stream survey reports documenting fish distribution in the assessment area were used when available to supplement the upstream extent surveys. Occasionally, locations expected to provide salmonid habitat (i.e., Class I streams) were not surveyed because of access restrictions on other ownerships.

Generally, salmonids were the most widely distributed of the fish species occurring in the assessment area. Based on the most recent data available, steelhead occur in all PWs, and coho salmon are found in at least 12 of the 15 PWs in the assessment area (See Figure D in the Figures Section). The East Branch North Fork Big River, Russian Gulch, and Mitchell Creek PWs were not found to support coho at present. However, comprehensive fish distribution surveys have not been conducted in the East Branch North Fork Big River PW, and further information is needed to determine the full extent of fish distribution in these three PWs, all of which contain relatively little JDSF ownership.

The other native fish species found during the CDFG stream surveys were Pacific lamprey (Lampetra tridentata), threespine stickleback (Gasterosteus aculeatus), and sculpin (Cottus sp.). Non-native fish species have been documented in the assessment area only in the South Fork Noyo River, where juvenile smallmouth bass (Micropterus dolomieu) were observed in the summer of 1995 approximately 9.5 miles (15 km) upstream from the confluence with Kass Creek, and one green sunfish (Lepomus cyanellus) was found in November of 1995 just upstream of the confluence with Parlin Creek. It is assumed that the fish of both species escaped from McGuire's Pond near the headwaters of the South Fork Noyo River.

Based primarily on channel gradient, steelhead were expected to occur in approximately 192 miles (309 km) of the Class I streams in the JDSF assessment area, many of which are outside of JDSF. Using the same methods, 123 miles (198 km) of Class I streams were identified as likely to support coho salmon. Of the 192 miles (309 km) of Class I stream length in the JDSF assessment area used in this analysis, steelhead were found in 64 percent (123 mi or 198 km). Coho were found in 75

percent (92 mi or 148 km) of their expected distribution (123 mi or 198 km), which equates to 48 percent of the Class I streams included in the analysis. Coho were also found in 2 miles (4 km) of Class I streams where they were not expected, based on channel gradient. Other salmonids (not identified as to species) were found in an additional 3 percent (6 mi [9 km]) of Class I streams. All together, salmonids were found in a total of 67 percent (129 mi or 208 km) of the Class I stream length analyzed in the assessment area.

These results indicate that coho and steelhead appear to be using a substantial amount of the stream mileage. However, neither species is distributed throughout the full extent of channels, which may be attributable to a lack of available or suitable habitat in these reaches. It may also indicate that populations are not fully seeding the available habitat (Nickelson et al. 1992).

Barriers to Fish Distribution

The CDFG survey crews documented 55 definite, probable, or possible barriers to fish migration in anadromous fish-bearing streams within JDSF (See Figure D in Figures Section). Four definite barriers consisted of a bedrock fall, two culverts, and one logging debris accumulation (LDA). There were two bedrock falls, three culverts, and eight LDAs forming probable barriers. The possible barriers were broken down into one bedrock falls, one culvert, one dam, one jump, and 34 LDAs. There are a total of 66 Class I stream crossings that may require inventorying using the CDFG protocol for fish passage.

In addition to the CDFG surveys, JDSF personnel identified or confirmed other barriers. In South Fork Hare Creek, no fish were observed above a debris jam 0.3 miles (0.5 km) from the confluence with the mainstem of Hare Creek. In the headwaters of North Fork of Caspar Creek, fish access ended at a debris jam, thought to be an old splash dam, 3.8 miles (6.1 km) from the confluence with South Fork Caspar Creek. Bedrock falls in the Middle Fork of Caspar Creek are reported to be a barrier to coho salmon. In upper South Fork Caspar Creek, a culvert was believed to end all upstream fish access until it was removed in 1998. Fish distribution data above this location are not currently available. A bedrock sheet located in an unnamed tributary to Parlin Creek was judged by CDFG to be a barrier to coho, and is reported to be a low flow barrier to steelhead. The dam spillway at McGuire's pond near the headwaters of the South Fork Noyo River is also a barrier to upstream fish migration.

In general, the confirmed barriers to fish migration are located near the headwaters of drainages such that they do not restrict access to substantial areas of potentially suitable habitat. Of the total length of Class I streams in the assessment area, only 3 percent (5.7 mi or 9.1 km) is upstream of confirmed barriers. These confirmed barriers therefore are not considered to limit coho or steelhead distribution significantly in JDSF. However, some Class I crossings may pose partial or temporary barriers to some salmonid life history phase and still need analysis.

Fish Abundance

Fish population data for the pre-logging period are not known to exist for streams in or near the JDSF assessment area. However, salmonid populations in Mendocino County are widely believed to have declined during this century compared to historical conditions (Nehlson et al. 1991; Brown

et al. 1994). In the absence of evidence that conditions in assessment area streams differ greatly from other Mendocino County streams, it is reasonable to assume that salmonid populations have likely declined from pre-logging levels in the assessment area. Data indicating regional declines of salmonid populations include counts of adult steelhead at Van Arsdale Fish Facility from 1933 through 1992 that went from more than 6,000 individuals to less than 500 (CDFG 1996a). In addition, numbers of coho crossing the Benbow Dam on the South Fork Eel River (approximately 50 mi or 81 km north of JDSF), declined from approximately 17,000 in 1945 to 509 in 1975 (CDFG 1996a).

There appears there may have been a shift in salmonid species dominance from coho to steelhead between 1967 and 1999 in the Little North Fork Noyo River (LNFNR) and Caspar Creek (Valentine 2002). Valentine's (2002) electrofishing results for the years 1992 -1999 were compared to those of Burns (1972) for the years 1967-1969. In the LNFNR 1967-1969 coho numbers in the survey reach ranged from 255 to 698, but fell to between 8 and 374 individuals during the years 1992-1999. During the same periods steelhead numbers increased from 19-29 to 246-443. Excluding 1967, the total number of salmonids ranged from 362-540 fish. Valentine (2002) also reported a decrease in coho biomass and an increase in steelhead biomass for generally the same time period. However, Valentine (2002) mentioned drought, instream flows, differences in survey techniques, salmonid access to survey reaches may influence the results.

Adult Spawners

Since 1979, CDFG has maintained a weir and coho salmon egg-taking station in JDSF, on the South Fork Noyo River near the confluence with the North Fork of the South Fork Noyo River . The weir consists of a channel-spanning cement dam (approximately 5 feet high) that directs adult salmon into a bunker where fish are counted, and can be detained or allowed to pass upstream. CDFG attempts to count 100 percent of the returning coho at the weir. However, fish are sometimes missed because of high flows and the fact that the trap is not in operation during the entire 3-month season.

The CDFG egg-taking station data cannot be used to discern coho population trends in the Noyo River since returns are dependent on the number of yearlings released. For example, no coho yearlings were released in 1999, which reduced the returns for the year 2001-2002 (Alan Grass, personal communication). The coho that were captured in 2001-2002 were all wild fish. In addition, fish spawn downstream of the weir in years with insufficient flow. From the winter of 1979–1980 through 2001-2002, the number of adult coho salmon returning to the egg-taking station ranged from a low of 46 fish in 1985–1986 to a high of 2,668 in 1987–1988 (Figure II). Reliable counts of steelhead at this station are not available because (1) the timing of steelhead spawning is such that the station is not in operation during most of the steelhead spawning season, and (2) the superior ability of steelhead to negotiate the weir at the station often enables them to avoid capture.

Juveniles

Downstream migrant traps have been operating in Caspar Creek, South Fork Noyo River, North Fork of the South Fork Noyo River, and Hare Creek collecting abundance data. Salmonid rearing density or total abundance are available. Downstream migrant trapping data and estimated usable habitat area were collated to derive smolt production estimates for coho and steelhead in Caspar

Creek for the period 1987–1996. The data from Caspar Creek are the most recent and regionally specific Salmonid population data for the assessment area, and provide a representative measure of the approximate production potential of other assessment area streams with similar habitat characteristics and physical parameters (e.g., drainage area, channel gradient). Habitat conditions and fish abundance in Caspar Creek are thought to be fairly representative of other streams in the assessment area, although no reliable fish abundance data are available to test this assumption.

A downstream migrant fish trap has been operated annually in the Caspar Creek basin since 1987 by the CDFG (CDFG 1996c). This trap is located on the mainstem of Caspar Creek, approximately 1 mile (1.6 km) downstream from the confluence with South Fork Caspar Creek. Weekly data summaries from the trap are currently available through 1996. It is apparent from the data that in some years, substantial numbers of age 0+ salmonids (fish up to 1 year of age) and age 1+ and older salmonids (fish greater than 1 year of age) were outmigrating prior to the start of the annual trapping effort. For this reason, the numbers reported here do not reflect the total number of Salmonid outmigrants in some years. The numbers of age 0+ coho salmon were likely substantially higher than reported in 1989, 1993, 1995, and 1996. Numbers of age 1+ coho outmigrants were likely higher than reported in 1987, 1990, and 1993; and numbers of age 1+ and older steelhead were likely higher than reported in 1987.

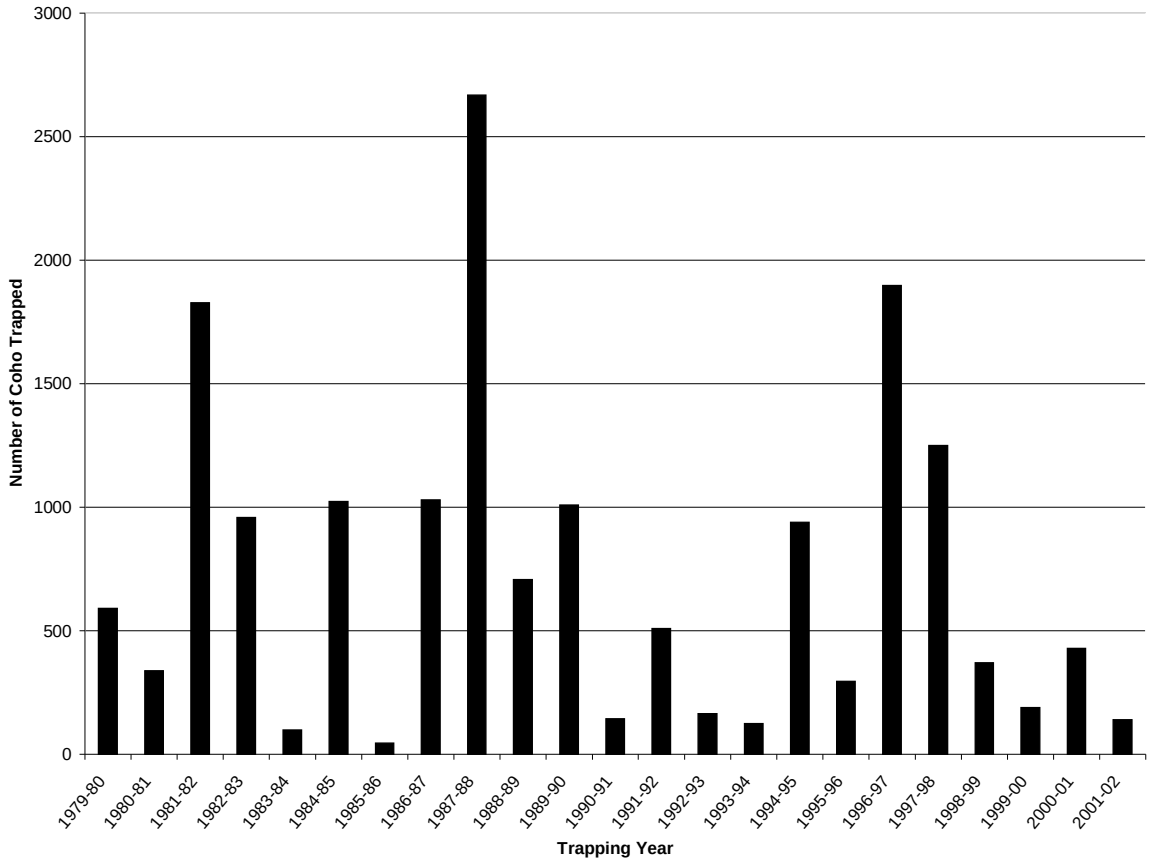

FIGURE II

Adult coho salmon trapped at the egg-taking station on the South Fork Noyo River

The number of age 0+ steelhead captured in the Caspar Creek trap over the 10-year period (1987–1996) ranged from 11 in 1987 to 19,139 in 1996 (Figure III) with an average of 5,661 for the period of record. Numbers of age 1+ and older steelhead ranged from 162 in 1991 to 1,193 in 1993 (Figure III) with an average of 438. Numbers of age 0+ coho captured over the 10-year period ranged from 43 in 1987 to 34,955 in 1989, with an average of 10,942. Numbers of age 0+ coho were unusually high in both 1988 and 1989. The number of age 1+ and older coho captured ranged from 662 in 1992 to 2,121 in 1990 and averaged 1,178 over the 10-year period.

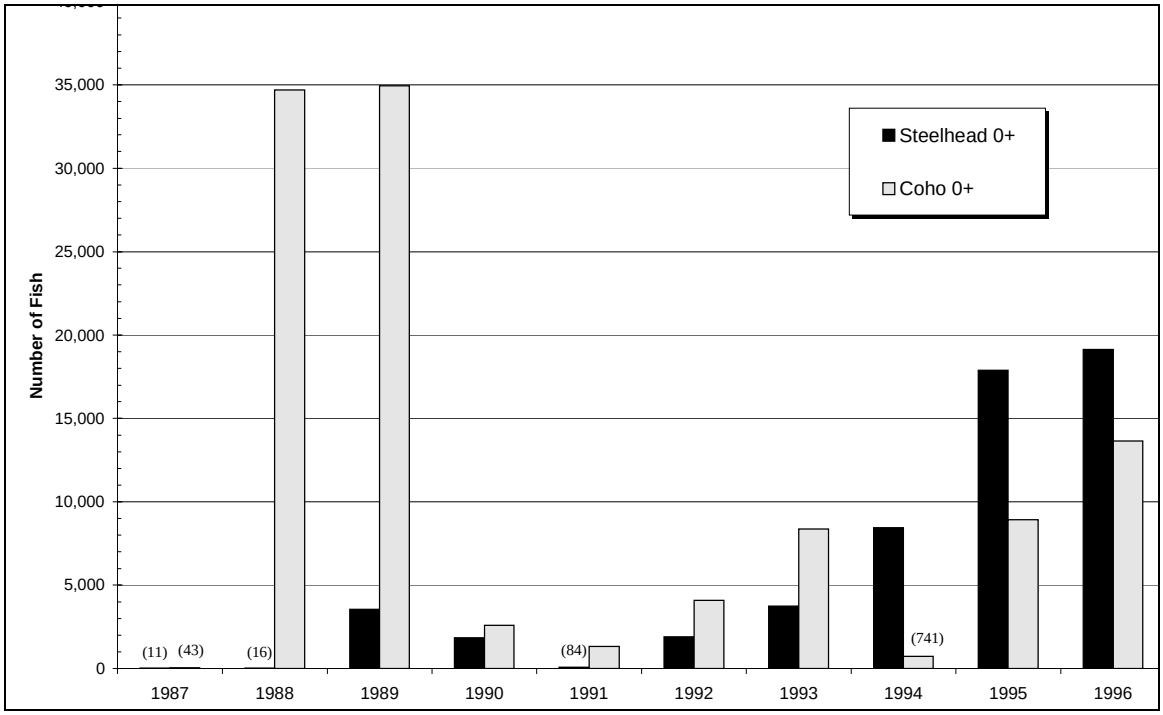

FIGURE III
Age 0+ downstream migrant salmonids in Caspar Creek, CA
(1987–1996; values less than 1,000 are shown in parentheses*)

* Data are from CDFG downstream migrant trapping program. Numbers may be underestimates owing to intermittent trap operation during high flows

The annual number of age 1+ coho and age 1+ and older steelhead outmigrants is a better indication of habitat-related factors and population trends than is the number of 0+ outmigrants. These older fish have spent at least one summer and winter rearing in freshwater habitats. Summer and winter rearing habitat conditions are thought to be the factors most limiting to coho salmon production (Nickelson et al., 1992), and may also be important factors governing steelhead populations. Populations of age 0+ coho salmon and steelhead outmigrants exhibit significant year-to-year variability. It is likely that the annual fluctuation in the number of age 0+ coho and steelhead outmigrants reflects annual variability in spawning escapement and egg-to-emergence survival as well as influences of carrying capacity.

Outmigration of coho smolts typically does not begin in California populations until the fish have reached a little over a year old (age Class 1+) (USFWS and USACOE 1987). Young steelhead and coho establish territories and defend them throughout most of their time rearing in freshwater

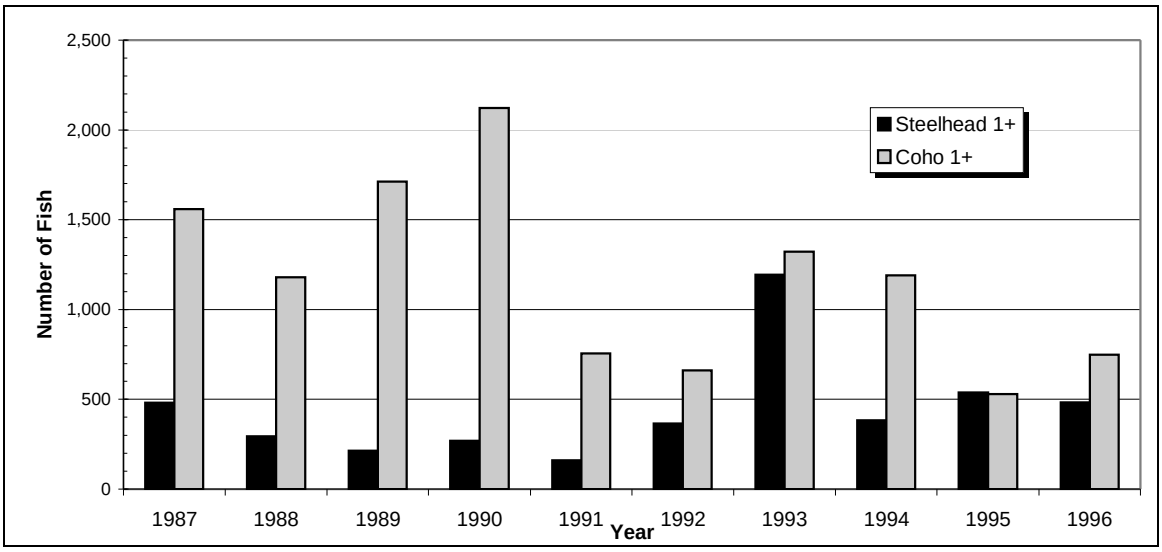

FIGURE IV

Age 1+ downstream migrant salmonids in Caspar Creek, CA. Note scale difference to Figure III. Date are from CDFG downstream migrant trapping program. Numbers may be underestimates due to intermittent operation during high flows.

(Hartman et al. 1982). The age 0+ outmigrating steelhead and coho observed in Caspar Creek are likely being displaced downstream by interspecific and possibly intraspecific competition, and are therefore considered surplus to the available habitat upstream of the trap. In addition, habitat conditions downstream of the trapping location are thought to provide relatively little overwintering habitat for these young outmigrating fish. Coho that enter salt water in their first summer or before are not thought to survive to adulthood (Hassler 1987). Therefore, the majority of age 0+ coho and steelhead outmigrants in Caspar Creek probably contribute little, if any, to the adult population.

No general trend is apparent in the numbers of age 1+ and older steelhead over this 10-year period (Figure IV). Annual variability in age 1+ and older steelhead and coho populations is apparently much less than age 0+ steelhead and coho populations. Additionally, there is no apparent relationship between the number of age 0+ outmigrants observed one year and the number of age 1+ outmigrants observed the following year (i.e., the same cohort) as would be expected if the available habitat was not fully seeded. The data suggest that annual fluctuations in age 1+ and older salmonids likely reflect varying environmental conditions related to summer and winter rearing, and may indicate that carrying capacity during summer and winter rearing is generally being reached each year.

The CDFG conducted downstream migrant trapping on the South Fork Noyo River and the North Fork of the South Fork Noyo River (Jones 2000, 2001). The results for the 2000 and 2001 trapping seasons are presented in Tables II and III. Trapping efficiencies for the year 2000 were 0.27 and 0.38 for S.F. Noyo and N.F-S.F. Noyo Age1+ coho respectively. Steelhead (Age 1+) trap efficiencies were 0.18 and 0.30 in the S.F. and N.F.-S.F. respectively. The CDFG estimated 2,416 (+/- 347) and 273 (+/- 95) Age 1+ coho migrated past the traps on the S.F. and N.F.-S.F. respectively. The CDFG estimated 2,251 (+/- 308) and 3,177 (+/- 339) Age 1+ steelhead migrated past the traps on the S.F. and N.F.-S.F. respectively.

Trapping efficiencies for the year 2001 were 0.34 and 0.08 for S.F. Noyo and N.F-S.F. Noyo Age1+ coho respectively. Steelhead (Age 1+) trap efficiencies were 0.14 and 0.02 in the S.F. and N.F.-S.F. respectively. The CDFG estimated 3,840 (+/- 1,067) and 312 (+/- 211) Age 1+ coho migrated past the traps on the S.F. and N.F.-S.F. respectively. The CDFG estimated 2,251 (+/- 308) and 3,177 (+/- 339) Age 1+ steelhead migrated past the traps on the S.F. and N.F.-S.F. respectively.

Table II
Year 2000 S.F. and N.F.-S.F. Noyo downstream migrant trapping results

	Yearling (1+)	Young of the Year	Total
Coho Salmon			
S.F. Noyo	553	1,350	1,903
N.F.-S.F. Noyo	77	33	110
Total	630	1,383	2,013
Steelhead			
S.F. Noyo	396	8,370	8,766
N.F.-S.F. Noyo	687	5,440	6,127
Total	1,083	13,810	14,893

Table III
Year 2001 S.F. and N.F.-S.F. Noyo downstream migrant trapping results

	Yearling (1+)	Young of the Year	Total
Coho Salmon			
S.F. Noyo	648	3,826	4,474
N.F.-S.F. Noyo	25	631	656
Total	673	4,457	5,130
Steelhead			
S.F. Noyo	174	151	325
N.F.-S.F. Noyo	90	0	90
Total	264	151	415

The USFS Redwood Sciences Laboratory conducted electrofishing surveys in North Fork and South Fork Caspar Creek from 1990 through 1995 (Nakamoto 1996). The surveys were made during summer months, and data were collected on densities of fish (coho salmon, steelhead, and three-spine stickleback) and of amphibians (Pacific giant salamander and tailed frog) in selected habitat types. The extensive data set provides detailed information on age 0+ and age 1+ and older salmonids (particularly steelhead). However, the number of adult coho returning to the areas sampled is thought to be low because they may have difficulty negotiating the North Fork and South Fork weirs. The number of steelhead returning to the areas sampled is not believed to be substantially affected by the weirs. Other data on fish presence and relative abundance in selected watersheds include qualitative values recorded in biological assessment reports prepared by CDF staff for THPs on JDSF (Valentine et al.1995a, 1995b, 1995c). Given the potentially low numbers of returning coho in Caspar Creek, only comparisons of steelhead densities between habitat types are reported here.

Electrofishing survey data for Caspar Creek describe summer rearing densities of steelhead in various habitat types defined by McCain et al. (1990). Fish densities from USFS electrofishing data (USFS 1996) were compared for those habitat units comprising the largest percentage of habitat

area from 6 years of surveys (1990–1995) in Caspar Creek (Figures V and VI). The six habitat types compared are low-gradient riffles (LGR), lateral scour pools associated with large organic debris (LSP-LOD), glides (GLD), runs (RUN), step-runs (SR), and lateral scour pools associated with boulders (LSP-BO).

Overall, densities of age 0+ steelhead varied more between years than between habitat types (see Figure V). Low-gradient riffles generally had the lowest densities of age 0+ steelhead among the habitat types compared. Densities of age 1+ steelhead were slightly more variable between habitat types than densities of age 0+ steelhead. Generally, age 1+ steelhead densities were higher in LSP-LOD, LSP-BO and GLD habitat types than in LGR, RUN, and SR habitat types (Figure VI). Comparison of steelhead densities between the North and South Forks of Caspar Creek revealed higher densities of steelhead in all North Fork habitat types except riffles.

Mean densities of age 1+ steelhead in Caspar Creek for the period 1990–1995 ranged from 0.04 fish per square foot (< 0.01 fish/m^2) in LGR habitats to 0.75 fish per square foot (0.07 fish/m^2) in LSP-LOD habitat types. These values are within the range of those reported in the published literature for other streams in northern California, Oregon, and Idaho. Depending on the habitat type and stream location, age 1+ steelhead density in pools, riffles, and glides ranged from about 0.11 fish per square foot (0.01 fish/m^2) to about 0.89 square foot (0.08 fish/m^2) in other Pacific Northwest streams (Bjornn and Reiser 1991). Burns (1971, 1972) measured similar steelhead densities in Caspar Creek before and after logging and road building in the late 1960s. Between 1967 and 1969, densities of late summer age 1+ steelhead in South Fork Caspar Creek ranged from 0.11 fish per square foot (0.01 fish/m^2) in 1968 to 0.43 fish per square foot (0.04 fish/m^2) in 1969 (Burns 1972). In North Fork Caspar Creek late summer densities of age 1+ steelhead were 0.22 fish per square foot (0.02 fish/m^2) in 1967 and 0.32 fish per square foot (0.03 fish/m^2) in both 1968 and 1969 (Burns 1971). Burns (1971, 1972) also made comparisons with steelhead densities in other northern California streams from the same time period. From 1967 to 1969, late summer densities of age 1+ steelhead in South Fork Yager Creek (in the Van Duzen River drainage) were similar to

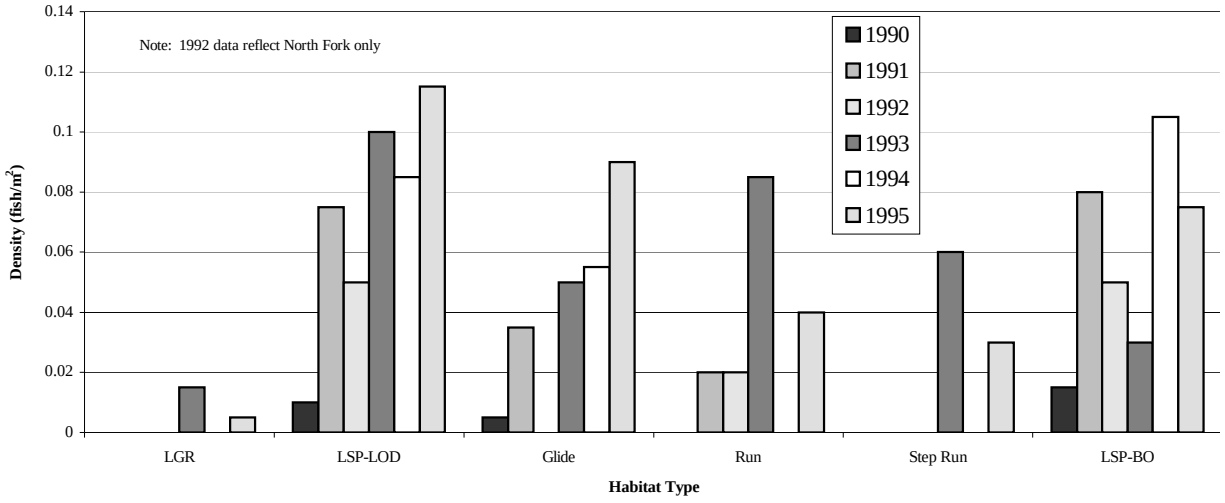

FIGURE VI
Mean density of age 1+ steelhead in various habitats of North and South Forks Caspar Creek

Caspar Creek densities, ranging from 0.22 fish per square foot (0.02 fish/m^2) to 0.44 fish per square foot (0.04 fish/m^2) (Burns 1972). However, Burns (1972) reported substantially higher densities in Bummer Lake Creek, a tributary to the Smith River. Late summer densities of age 1+ steelhead in Bummer Lake Creek ranged from 0.86 fish per square foot (0.08 fish/m^2) in 1969 to 1.56 fish per square foot (0.14 fish/m^2) in 1967 (Burns 1972).

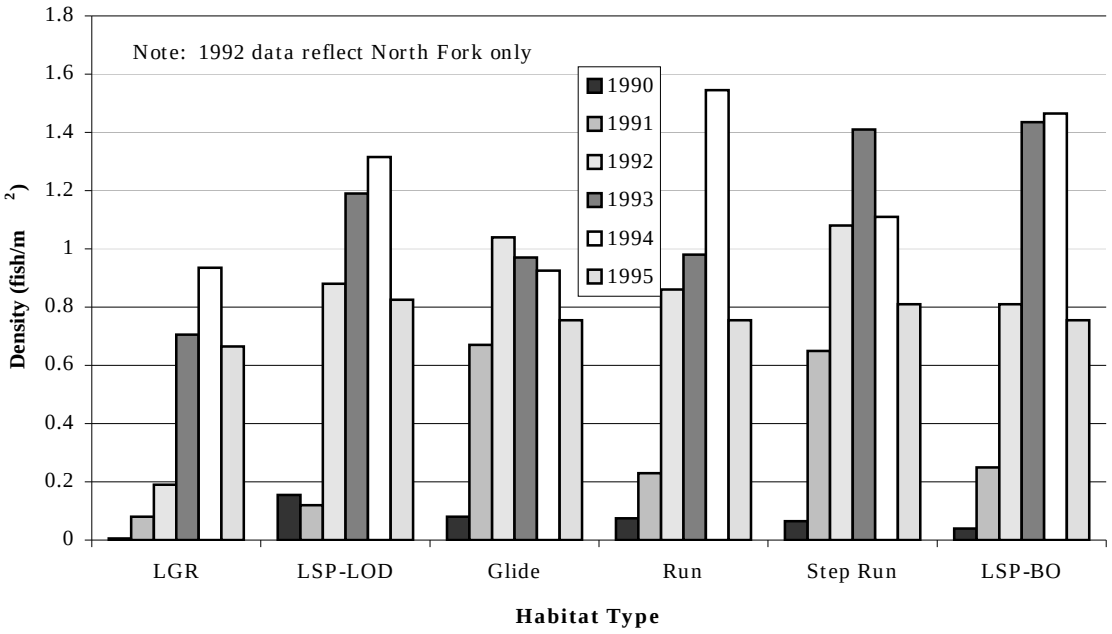

FIGURE V
Mean density of age 0+ steelhead in various habitats of North and South Forks Caspar Creek

3. LIFE HISTORY AND HABITAT REQUIREMENTS OF COHO SALMON AND STEELHEAD

Spawning, summer rearing, and winter rearing are important stages in the freshwater life history of anadromous salmonids; and specific physical habitat conditions are required for each. Habitat requirements of coho and steelhead at each of these life history stages are discussed below, with a summary of the potential impacts that forest management activities can have on these habitat parameters.

Spawning

Coho salmon and steelhead return to spawn in their natal streams in response to seasonal changes in stream flows or temperatures. Spawning sites (redds) are usually located near the heads of riffles (pool tailouts) where the water changes from a smooth to a turbulent flow, and where there exists well oxygenated and relatively silt-free coarse gravels, and nearby cover for adults (Bjornn and Reiser 1991; Moyle et al. 1995). Gravel sizes used for construction of redds range from 1.3–10.2 centimeters (0.5-4 in) in diameter for coho (Bjornn and Reiser, 1991), and from 0.64–13 centimeters

(0.25-5 in) for steelhead (Barnhart 1986). Water temperatures between 3° and 14°C (37° and 56°F) are within the range reported as suitable for spawning coho (Bell 1986), and water temperatures between 10° and 15°C (50° and 59°F) are preferred by adult steelhead (Moyle et al. 1995).

Spawning also requires the presence of suitable depth and velocity conditions, and adequate space and gravel availability for redd construction. Water depths of at least 24 cm (9.4 in) and velocities of 40–91 cm per second (1.3–3 ft/s) are typically preferred by steelhead (Smith 1973, cited in Bjornn and Reiser 1991), while spawning coho salmon reportedly prefer water depths greater than 18 cm (7 in) and velocities of 30–91 cm per second (1-3 ft/s) (Thompson 1972, cited in Bjornn and Reiser 1991). Coho salmon redds averaged 2.8 m^2 (30 ft^2) in area and steelhead redd have an average area of 4.4 m^2 (47 ft^2) (Burner 1951 and Reiser and White 1981 *in* Bjornn and Reiser 1991).

Survival from egg to emergence is closely related to the permeability of the spawning gravels and the dissolved oxygen supply available to them. Excessive amounts of fine sediment in redds could reduce the amount of dissolved oxygen reaching the eggs (Chapman 1988; Bjornn and Reiser 1991).

The quantity, quality, and spatial distribution of spawning gravels, as well as water depth and velocity in spawning areas, can suffer substantial negative impacts from forest management and other land use activities, resulting in decreased survival. Sedimentation resulting from either natural or anthropogenic disturbances is typically considered the principal cause of salmonid egg and alevin mortality (Shapovalov and Taft 1954; Chapman 1988). Removal of LWD from stream channels also reduces pool quantity and quality (Bisson et al., 1987) and affects the storage and distribution of sediment (Lisle and Napolitano 1998).

Rearing

After emerging from the gravel, juvenile coho and steelhead spend at least one summer rearing in fresh water before migrating to the ocean. Food and cover are two of the most important factors influencing juvenile rearing success. Production of aquatic macroinvertebrates used as the primary food resource of salmonids during their freshwater residence depends on the availability of relatively silt-free, heterogeneous substrate; cold, well-oxygenated water; and the supply of organic matter and nutrients to the stream (Bjornn and Reiser 1991). Relatively cold-water temperatures are also required for growth and survival of juvenile coho and steelhead. In late summer or fall, when stream temperatures are generally highest and flows lowest, low flows result in reduced area for rearing, increased vulnerability to predation, and increased incidence of thermal stress. Burns (1971) found that the highest mortality of juvenile coho during summer occurred in the periods of lowest flow. Juvenile coho appear to prefer temperatures of 10° to 15° C (50° to 59°F) (Hassler 1987), and Brett (1952) found that exposure to temperatures in excess of 25° C (77°F) resulted in a high mortality rate. Preferred rearing temperatures reported for steelhead range from 7° to 15°C (44.5° to 59°F), with optimum water temperatures for juveniles occurring around 10°C (50°F) and lethal temperatures occurring at approximately 23.9°C (76°F) (Bjornn and Reiser 1991).

During the juvenile rearing period, steelhead appear to use habitats with swifter water velocities and shallower depths than do coho salmon (Bisson et al. 1988; Fausch 1993). In comparison to juvenile coho, steelhead have a body shape that is better adapted to holding and feeding in swifter currents (Bisson et al., 1988). Where the two species coexist, as they do in most JDSF streams, their

preferred rearing habitats are generally spatially segregated, especially during the summer months. While juvenile coho salmon are strongly associated with low velocity habitats such as pools throughout the rearing period (Shirvell 1990), steelhead will use riffles (age 0+ fish) and deep run and pool habitats (age 1+ fish) in the summer (Barnhart 1986). Other stream habitats such as riffles and glides may be occupied during the summer, but the density of juvenile coho found in these habitats is usually much lower than in pool or off-channel habitats. However, Harvey and Nakamoto (1996) found that juvenile coho salmon weight was negatively related to the density of steelhead.

After emergence, steelhead fry move to shallow, low-velocity habitats such as stream margins (Barnhart 1986). As the fry increase in size and their swimming abilities improve, they will move into low-gradient. As fry increase in size in late summer and fall, they increasingly use areas with cover and show a preference for higher-velocity, deeper mid-channel areas near the thalweg (Everest and Chapman 1972). In general, age 0+ steelhead are found in a wide range of hydraulic conditions, although their spatial distribution may be affected by the presence of juvenile coho salmon, which tend to displace juvenile steelhead from pools. Age 0+ steelhead have been found to be relatively abundant in backwater pools and in the downstream ends of pools (Bisson et al. 1988). Older age classes of juvenile steelhead are found in a variety of habitats, but tend to prefer deeper water during the summer and have been observed to use deep pools near the thalweg that have ample cover as well as higher velocity rapid and cascade habitats (Bisson et al. 1988). Interstitial spaces within the substrate are often used as cover by juvenile steelhead, especially during high flows or periods of low temperature (Bisson et al. 1988; Bjornn and Reiser 1991). During the summer, steelhead parr appear to prefer habitats with rocky substrates, overhead cover, and low light intensities (Fausch 1993).

Chronic turbidity in streams during emergence and rearing of young salmonids could affect the numbers and quality of fish produced (Sigler et al. 1984; Berg and Northcote 1985; Newcombe and MacDonald 1991). Salmonids respond to both the duration of exposure and concentration of suspended sediment (Newcombe and MacDonald 1991). Effects of suspended sediment episodes range from changes in territorial, gill flaring, and feeding behavior for short-term, low concentration exposure (Berg and Northcote 1985) to reduced growth rates and mortality for longer duration/high concentration events (Newcombe and MacDonald 1991). See Hydrology section for additional information on suspended sediment concentrations and turbidity.

During winter high flow events, floodplains, alcoves, side channels, LWD accumulations, deep pools (>3.3 ft or 1 m), and substrate interstices are important in providing velocity refugia for rearing salmonids (Bjornn and Reiser 1991). Streams in JDSF are primarily confined and therefore generally lack off-channel habitats such as side channels and floodplains that would otherwise provide high-quality overwintering habitat for juvenile coho salmon. In confined channels such as these, deep pools with LWD are preferred as winter habitat, and may be critical for preventing downstream displacement and mortality during high flow events. Because juvenile coho salmon show narrower preferences for pool habitat types in the winter than in the summer, and because of the lack of off-channel habitat in these confined channels, habitat limitations in the assessment area may be more common in the winter.

Lack of suitable winter habitat may be the most significant factor limiting coho salmon production (Chapman and Knudsen 1980; Nickelson et al. 1992). Tschaplinski and Hartman (1983) documented substantial decreases in juvenile coho salmon numbers in fall and winter, particularly

in response to seasonal freshets. They found that habitats such as deep pools, logjams, and undercut banks with woody debris lost fewer fish during high flow events and maintained higher juvenile populations over the winter.

4. AQUATIC MACROINVERTEBRATES

Aquatic invertebrates are an important food source for juvenile salmonids, and their abundance is therefore indicative of food availability. Many amphibian species, such as the northern red-legged frog, foothill yellow-legged frog, rough-skinned newt, and aquatic reptiles (e.g., northwestern pond turtle), also depend on aquatic invertebrates as food. Aquatic macroinvertebrates can be also be used as indicators of general water quality and impacts to stream ecosystems (Harrington 1994). Valentine et al. (1995a) reported that the aquatic macroinvertebrate community in a portion of the Little North Fork Big River was examined in May 1995 by Resh using a variation of the California Stream Bioassessment Procedure. Resh stated that the assessment parameters indicated that good habitat conditions were present.

Botorff and Knight (1996) conducted a much more detailed study of aquatic macroinvertebrate populations in North Fork Caspar Creek. Their results showed that changes to the overall benthic community structure occurred following logging of the watershed, but expected decreases in abundance and taxa richness were not observed. Increases in macroinvertebrate density and taxa richness, as well as increased leaf decay rates and algal biomass, were reported. They speculate that few negative effects on macroinvertebrates occurred following increased deposition of fine sediment related to logging because the macroinvertebrate fauna of North Fork Caspar Creek had already adapted to high fine sediment levels in the substrate from old growth logging 100 years earlier (Botorff and Knight 1996).

APPENDIX 8D-1
SPECIES DESCRIPTIONS FOR RARE, THREATENED, ENDANGERED, AND SENSITIVE PLANT SPECIES POTENTIALLY OCCURRING ON JDSF

Arctostaphylos mendocinoensis—*pygmy manzanita*

Pygmy manzanita is a low-growing, mat-forming evergreen shrub in the heath family (Ericaceae). Stems are covered in a peeling, reddish-brown bark, and the twigs are sparsely fine-bristly (Hickman 1993). The leaves are five to 12 mm long, three to seven mm wide, oblong-elliptic, base obtuse and margin entire. The upper surface is convex, dark green, shiny, and glabrous. Small urn-shaped flowers are borne on densely flowered inflorescences in January (Hickman 1993). This species occurs in association with Mendocino pygmy forest on acidic (podzolized), sandy-clay soils within closed-cone coniferous forest from 90 to 200 meters (CNPS 2001, Hickman 1993). There is only one known occurrence of pygmy manzanita. The one known site is in the Mendocino (569D) USGS 7.5' quadrangle in Mendocino County (CNPS 2001). Pygmy manzanita has been recorded in the Western and Southern WWAAs both within and outside JDSF.

The current population status and trend for pygmy manzanita are uncertain but presumed to be declining. Activities associated with timber harvesting, road construction or maintenance, and urban development could adversely affect this species through habitat modification and direct injury to plants. Study is needed for adequate conservation management.

Arenaria paludicola—*marsh sandwort*

Marsh sandwort is a stoloniferous perennial herb in the pink family (Caryophyllaceae). It is glabrous, flaccid, and has leafy angled stems that can reach seven dm long (Munz and Keck 1959). Leaves are uniform, flat, lance-linear, narrowly acute, 1.5 to four cm long, and somewhat connate (Hickman 1993, Munz and Keck 1959). Flowers are solitary and axillary with five to six mm petals. Fruits are oblong capsules with six teeth and are approximately as long as the sepals (up to 3.5 mm). Flowers bloom from May to August (CNPS 2001). Habitat includes Bogs and fens, Marshes and Swamps up to 170 meters (freshwater; CNPS 2001), boggy meadows, and marshes (Hickman 1993).

Known occurrences for marsh sandwort include Los Angeles [extirpated], Mendocino, San Bernardino [extirpated], Santa Cruz [extirpated], San Francisco [extirpated], San Luis Obispo, and it has been extirpated from Washington (CNPS 2001). In Mendocino County it is known from the Inglenook (585D) USGS 7.5' quadrangle. It is not known from the JDSF.

Current population status and trend for marsh sandwort are unknown. Activities associated with timber harvesting, road construction and maintenance, and rural or urban development could adversely affect this species through loss of suitable habitat, habitat modification, and direct injury to plants. Known from only two occurrences at Inglenook Fen (Mendocino Co.) and Black Lake Canyon. (San Luis Obispo Co.; CNPS 2001). Threatened by development, erosion, and non-native plants.

***Astragalus agnicidus*— Humboldt milk-vetch**

Humboldt milk-vetch is a tall, three to nine dm, erect perennial herb in the legume family (Fabaceae). Leaves are once odd-pinnate and are composed of 13 to 27 sparsely-hairy leaflets (Hickman 1993). Racemes contain ten to 40 white pea-like flowers. Fruits are flat and hairy. This species blooms from June to September (CNPS 2001). Habitat includes open soil in woodlands, around 750 meters in elevation (Hickman 1993), disturbed openings in the Broadleaved Upland Forest (Skinner and Pavlik 1994), disturbed woods around 750 meters in elevation (Munz and Keck 1959), and North Coast Coniferous Forest and disturbed areas from 195 to 750 meters in elevation (CNPS 2001).

Known occurrences for Humboldt milk-vetch include Humboldt and Mendocino Counties (CNPS 2001). In Mendocino County it has been found on the Noyo Hill (568B) USGS 7.5' quadrangle. This species is known from the Southern WWAA.

Current population status and trend for Humboldt milk-vetch are declining (CDFG 2000a). TNC had been the primary leader in coordinating protection and monitoring on Humboldt milk-vetch for ten years. However, since 1998, CNPS has taken over the coordination of monitoring and protection activities. A management plan is in preparation (CDFG 2000a). Though Humboldt milk-vetch is an early colonizing species that utilizes forest and woodland openings, activities associated with timber harvesting, road construction and maintenance, and rural or urban development could adversely affect this species through loss of suitable habitat, habitat modification, and direct injury to plants. Study is needed for adequate conservation management.

Calamagrostis bolanderi—*Bolander's reed grass*

Bolander's reed grass is a rhizomatous perennial grass that can appear to grow in small clumps. Flowering stems are 1 to 1.5 m tall with broad flat leaves (3 to 10 mm wide) and open panicles (Hickman 1993, Munz and Keck 1959). Spikelets have one floret. A geniculate awn is attached to the base (rather than middle) of each lemma (Hickman 1993). This species blooms from May to August (CNPS 2001). Habitat includes bogs, moist meadows, open woodlands at less than 100 meters in elevation (Hickman 1993), and bogs and fens, Closed-Cone Coniferous Forest, Coastal Scrub, Meadows (mesic), Marshes and Swamps (freshwater), North Coast Coniferous Forest/mesic at zero to 305 meters (CNPS 2001).

Known occurrences of Bolander's reed grass include Humboldt, Mendocino, and Sonoma Counties (CNPS 2001). In Mendocino County it has been found on the Elk (552B), Eureka Hill (537A), Fort Bragg (569A), Gualala (537D), Mendocino (569D), Noyo Hill (568B), and Point Arena (537B) USGS 7.5' quadrangles. It is known from the JDSF.

Current population status and trend for Bolander's reed grass are unknown. Activities associated with timber harvesting, road construction and maintenance, and rural or urban development could adversely affect this species through loss of suitable habitat, habitat modification, and direct injury to plants. Study is needed for adequate conservation management.

Campanula californica—*swamp harebell*

Swamp harebell is a perennial herb in the bellflower family (Campanulaceae) that grows from slender underground rhizomes. The stems are simple or few-branched and have recurved stiff hairs, feeling rough to the touch (Hickman 1993, Munz and Keck 1959). The plants reach 10 to 30 cm and produce pale blue, bell-shaped flowers from June through October (CNPS 2001, Hickman 1993). This species is found in Coastal Prairie, Closed-cone Pine Forest, North Coastal Coniferous Forest / mesic, Bogs and Fens, Marshes and Swamps, Meadows and seeps, and elevations from one to 405 meters (CNPS 2001).

Swamp harebell occurs in Mendocino, Marin, and Sonoma Counties and was extirpated from Santa Cruz County (CNPS 2001). In Mendocino County, the species is known to occur within the Albion (553A), Elk (552B), Fort Bragg (569A), Gualala (537D), Inglenook (585D), Mathison Peak (568C), Mendocino (569D), Navarro (552A), Noyo Hill (568B), Point Arena (537B), Saunders Reef (537C), and Tomales (485B) USGS 7.5' quadrangles (CNPS 2001). Swamp harebell is known to occur on the JSDF.

The population status and trend of the swamp harebell are uncertain. Though a population in Sonoma County was observed densely covering an area of approximately 1,000 square feet, many of the documented occurrences of swamp harebell are represented by very few plants (CNPS 2001).. The swamp harebell is considered threatened by grazing, development, marsh habitat loss, and logging (CNPS 2001). Activities associated with timber harvesting and road construction or maintenance could affect this species through habitat modification and direct injury to plants. Study is needed for adequate conservation management.

Carex arcta—northern clustered sedge

Northern clustered sedge is a perennial, cespitose, grass-like herb of the sedge family (Cyperaceae). Stems and leaves are densely clustered, and plants grow to 80 cm tall (Munz and Keck1959). Leaf blades are two to four mm wide with a sparsely red-dotted lower sheath (Hickman 1993, Munz and Keck 1959). The inflorescence is dense with seven to fifteen distinct spikelets. Each spikelet is 1.5 to three cm long and are gynaecandrous (the lower more or less separate). The plants bloom from June to August (CNPS 2001). Habitat includes wet places, especially bogs (Hickman 1993), wet soils of bogs and marshes (Munz and Keck 1959), and Bogs and fens, mesic North Coast coniferous forest (CNPS 2001), and elevations range from 60 – 1400 meters (CNPS 2001).

Northern clustered sedge occurs in Del Norte, Humboldt, Mariposa, and Tulare counties (CNPS 2001). CNPS records are unclear as to whether this species occurs in Mendocino County. Northern clustered sedge is also known from Idaho, Oregon, and Washington and is more widespread outside of California. It is expected to occur in Mendocino county in the habitat types present on the JDSF.

The population status and trend of the northern clustered sedge are uncertain. Activities associated with timber harvesting and road construction or maintenance could affect this species through habitat modification and direct injury to plants.

Carex californica—*California sedge*

California sedge is a perennial, rhizomatous herb of the sedge family (Cyperaceae). It is scarcely cespitose, and the stems are 20 to 70 cm, erect, and much longer than leaves (Hickman 1993, Munz and Keck 1959). The leaves are two to five mm wide, flat, gray-green, and glandular-papillate. Plants are monoecious with two to six spikelets; the terminal spikelet is staminate, linear, 1.5 to 3.5 cm in length, and usually long-stalked. The lateral spikelets are pistillate, generally linear-oblong, one to four cm long, and the lowest spikelet has a long-sheathing bract. This species blooms from May to August (CNPS 2001). California sedge is found in coastal flats (Munz and Keck 1959), meadows, drier areas of swamps (Hickman 1993), Bogs and fens, Closed-cone coniferous forest, Coastal prairie, Meadows, Marshes and Swamps (margins) at elevations ranging from 90-335 meters (CNPS 2001).

California sedge is known from Mendocino county and may occur in Sonoma county as well. It is also known from Idaho, Oregon, Washington, and other states. California sedge is known from the Albion (553A), Elk (552B), Eureka Hill (537A), Fort Bragg (569A), Mathison Peak (568C), Mendocino (569D), Noyo Hill (568B), Point Arena (537B) USGS 7.5' Quadrangles. It has been found in the JDSF.

Current population status and trend for California sedge are unknown. Reported threats to the species include road building, residential development, over-grazing, and impacts associated with illegal dumping (CDFG 2001). Activities associated with recreation, timber harvesting, and road construction or maintenance could affect this species through habitat modification and direct injury to plants. Study is needed for adequate conservation management.

Carex livida—livid sedge

Livid sedge is a perennial rhizomatios herb of the sedge family (Cyperaceae). Flowering stems range from 15—60 cm tall with blades 1 – 3.5 mm wide (Hickman 1993). The lowest spikelet bract sheath is grater than 6 mm, and pistillate bracts are red-brown. Habitat includes bogs and swamps (Hickman 1993, CNPS 2001).

Livid sedge is known from one occurrence in California in Mendocino County. It was found approximately one mile south of JDSF in a bog, and has since been extirpated in California.

Though extirpated, this species should be included in survey efforts.

Carex saliniformis—*deceiving sedge*

Deceiving sedge is a perennial rhizomatous herb of the sedge family (Cyperaceae). It is loosely cespitose with flowering stems five to 15 cm tall and leaf blades two to five mm wide (Abrams 1940 Vol. I, Hickman 1993). Each plant has three or four pistillate spikelets present and a solitary staminate spikelet. The pistillate florets have two stigmas each. The lowest pistillate floret bracts are often leaf-like and green with a white or red-brown margin. The lowest staminate floret bract is often greater than 1/3 the spikelet length. Deceiving sedge blooms in June (CNPS 2001). Habitat includes Moist to wet, open areas at less than 120 meters in elevation (Hickman 1993), and Coastal prairie, Coastal scrub, Meadows, Marshes and Swamps (coastal salt)/mesic at up to 230 meters in elevation (CNPS 2001).

Known occurrences of deceiving sedge include Humboldt, Mendocino, Santa Cruz (extirpated), and Sonoma Counties (CNPS 2001). In Mendocino it is located on the Elk (552B), Eureka Hill (537A), Fort Bragg (569A), Inglenook (585D), Mallo Pass Creek (552C), Mendocino (569D), Noyo Hill (568B), and Point Arena (537B) USGS 7.5' quadrangles. It is not known from the JDSF.

Current population status and trend for deceiving sedge are unknown. Activities associated with timber harvesting, road construction and maintenance, and rural or urban development could adversely affect this species through loss of suitable habitat, habitat modification, and direct injury to plants

Carex viridula *var*. viridula—*green sedge*

Green sedge is a perennial, herbaceous, grass-like member of the sedge family (Cyperaceae). The plants are densely cespitose in small clumps and the rootstock is very short (Hickman 1993, Munz and Keck 1959). The stems are five to 40 cm tall and erect. The leaves are 1.5 to three mm wide with blades channeled. The monoecious plants bear dense inflorescences with terminal, and often one to two subsidiary, staminate spikelets that are one to two mm wide and linear. The lateral spikelets are sessile (lowest one stalked and erect), oblong to round, and five to 10 mm long. The blooming period is June through September (CNPS 2001). Habitat includes low wet ground near the coast, North Coast Coniferous Forest (Munz and Keck 1959), Sphagnum Bogs (Hickman 1993), Bogs and fens, Marshes and Swamps (freshwater), and mesic North Coast coniferous forest (CNPS 2001). Elevations range from zero to 1600 meters (Hickman 1993, CNPS 2001).

Known occurrences of green sedge include Del Norte, Humboldt, and Mendocino counties (CNPS 2001). In Mendocino county, green sedge is known from the Inglenook (585D) USGS 7.5' quadrangle. It is not known from the JDSF.

Current population status and trend for green sedge are unknown. Activities associated with timber harvesting, road construction and maintenance, and rural or urban development could adversely affect this species through loss of suitable habitat, habitat modification, and direct injury to plants. Most known California locations are in or near lagoons or bogs (CNPS 2001). Activities that threaten these habitat types include recreation and development.

Castilleja mendocinensis—*Mendocino coast Indian paintbrush*

Mendocino coast Indian paintbrush is a perennial, hemiparasitic herbaceous member of the figwort family (Scrophulariaceae). Plants are much-branched and have woody bases (Hickman 1993, Nakamura and Nelson 2001). Leaves are sessile, five to 20 mm, oblong to rounded, generally entire, fleshy, and shaggy-hairy. Inflorescences are five to 20 cm in length and have bracts of 15 to 20 mm in length. Bracts have one to three lobes and are bright red to orange-red. Flowers have calyces of 20 to 25 mm and corollas of 30 to 45 mm; the upper portion of the corolla is longer than the colored bracts and calyces. This species blooms April through August (CNPS 2001). Habitats include coastal scrub (CNPS 2001, Hickman 1993) and Coastal bluff scrub, Closed-cone coniferous forest, Coastal dunes, and Coastal prairie (CNPS 2001). Elevation range is zero to 160 meters (CNPS 2001).

Mendocino coast Indian paintbrush is known from Humboldt and Mendocino counties (CNPS 2001). It is also found in Oregon. In Mendocino, this species occurs on the Albion (553A), Bear Harbor (601B), Elk (552B), Fort Bragg (569A), Gualala (537D), Hales Grove (601D), Inglenook (585D), Mallo Pass Creek (552C), Mendocino (569D), Saunders Reef (537C), and Westport (585A) USGS 7.5' quadrangles. Due to the habitat and range of this species, it is likely that it occurs on the JDSF, but no locations are currently known.

The current population status and trend for Mendocino coast Indian paintbrush are unknown. Possible threats include development, logging, road construction and maintenance, and collection. Activities associated with timber harvesting and road construction or maintenance could affect this species through habitat modification and direct injury to plants. Study is needed for adequate conservation management.

Cupressus goveniana *ssp*. pigmaea—*pygmy cypress*

Pygmy cypress is a small, evergreen, closed-cone coniferous tree in the Cypress family (Cupressaceae). Trees grow one to two meters in sterile soil, and 10 to 50 meters in rich soil, and have gray-brown shredding bark (Hickman 1993, Munz and Keck 1959). Cones are serotinous and release seeds after fire exposure, on hot humid days, or as the result of desiccation due to old age or death of the tree. Bare mineral soil conditions are necessary for maximal germination and seedling establishment. Habitats include closed-cone pine/cypress forest, coastal terraces (Hickman 1993, Munz and Keck 1959), coastal coniferous forest (Stuart and Sawyer 2001), and podzol-like soils in Closed-cone coniferous forest (CNPS 2001). Elevations range from 30-500 meters (CNPS 2001).

Pygmy cypress occurs in Sonoma and Mendocino Counties (CNPS 2001). In Mendocino County, this taxon occurs in the Comptche (568D), Elk (552B), Eureka Hill (537A), Fort Bragg (569A), Gualala (537D), Mathison Peak (568C), Mendocino (569D), Noyo Hill (568B), Point Arena (537B), and Saunders Reef (537C) USGS 7.5' Quadrangles. Pygmy cypress has been recorded in the Western and Southern WWAAs, both within and outside JDSF.

The current population status and trend are uncertain, but the pygmy cypress is considered at risk from development, vehicles, and fire suppression (CNPS 2001). Activities associated with timber harvesting and road construction or maintenance could affect this species through habitat modification and direct injury to plants. Frequent stand-replacing fires may eliminate pygmy cypress groves entirely if fire returns at an interval shorter than that required for young trees to produce seed-bearing cones. Study is needed for adequate conservation management.

***Erythronium revolutum*—coast fawn lily**

Coast fawn lily is a perennial, bulbiferous herbaceous member of the lily family (Liliaceae). Leaves are 10 to 25 cm, widely lanceolate to ovate, entire to wavy-margined, and have brownish-red or white mottles (Hickman 1993, Munz and Keck 1959). Inflorescences have one to three pink to white flowers. Perianth segments are 25 to 40 mm, lance-linear, acuminate to acute, and often have involute margins and transverse yellow bands near the base. This species blooms March through June (CNPS 2001). Habitats include Streambanks and wet places in woodlands (Hickman 1993), margins of swamps and bogs in redwood and mixed evergreen forest (Munz and Keck 1959), and Bogs and fens, Broadleaved upland forest, mesic North Coast coniferous forest, and streambanks (CNPS 2001). Elevation range is zero to 1065 meters (CNPS 2001).

Coast fawn lily is known from Del Norte, Humboldt, Mendocino, Siskiyou, and Sonoma counties (CNPS 2001). It is also found in Oregon (watch list), Washington (state-listed species), and other states. In Mendocino, coast fawn lily occurs on the Comptche (568D) and Piercy (601A) USGS 7.5' quadrangles. Due to the habitat and range of this species, it is likely that it occurs on the JDSF, but no locations are currently known.

The current population status and trend for coast fawn lily are unknown. Possible threats include development, logging, road construction and maintenance, and collection. Activities associated with timber harvesting and road construction or maintenance could affect this species through habitat modification and direct injury to plants.

Fritillaria roderickii—Roderick's fritillary

Roderick's fritillary is a perennial, bulbiferous herb of the lily family (Liliaceae). Stems are one to 4.5 dm with three to seven alternate, often crowded, leaves (Hickman 1993). Leaves are eight to 40 mm wide and oblong to narrowly ovate. Flowers are nodding and have perianth parts of 1.8 to four cm that are narrowly ovoid, dark brown to greenish purple, and without unpleasant odor (as opposed to the similar *F. agrestis*). Plants bloom March through May (CNPS 2001). Habitats include Coastal bluff scrub, Coastal prairie, and Valley and foothill grassland (CNPS 2001). Elevation range includes 15-120 meters (CNPS 2001).

Roderick's fritillary known from fewer than ten occurrences in Mendocino county. Plants introduced in Mendocino (537D) and Sonoma counties (CNPS 2001). Occurrences are listed for the Boonville (551D), Fort Bragg (569A), Laughlin Range (567D), Philo (551C), Point Arena (537B) [extirpated], and Saunders Reef (537C) USGS 7.5' quadrangles. There is a high likelihood that this plant occurs on the JSDF.

Roderick's fritillary is threatened by road maintenance, residential development, and erosion (CNPS 2001). Activities associated with timber harvesting and road construction or maintenance could affect this species through habitat modification and direct injury to plants. The population is in decline (CDFG 2000b). The taxonomic validity of this species has been questioned, and further study is needed. *F. roderickii* is a synonym of *F. biflora* var. *biflora* in *The Jepson Manual*. USFWS uses the name *F. grayana*.

Horkelia marinensis—Point Reyes horkelia

Point Reyes horkelia is a mat-forming perennial herb in the rose family (Rosaceae). Stems are decumbent to ascending and generally 10 to 30 cm (Hickman 1993). Flowering stems are sparsely leafy. Vegetation is pale yellow-green, shaggy-villous, finely glandular, and "rankly aromatic" (Hickman 1993, Munz and Keck 1959). Leaves have five to 10 wedge-shaped leaflets crowded together on each side. Leaflets have five to 10 teeth and are dissected one third to half way to the base. Inflorescences are dense and have five to 10 flowers each. Petals are white and are four to six mm long. Plants flower from May to September (CNPS 2001). Habitats include Coastal dunes, Coastal prairie, Coastal scrub / sandy (CNPS 2001), and sandy coastal flats (Hickman 1993). Elevation range includes five to 350 meters (CNPS 2001).

Point Reyes horkelia is known from Mendocino, Marin, Santa Cruz, San Mateo counties (CNPS 2001). It is known from the Fort Bragg (569A), Gualala (537D), Inglenook (585D), Noyo Hill (568B), Saunders Reef (537C), and Westport (585A) USGS 7.5' quadrangles in Mendocino county. It is not known from any locations on the JDSF.

Population status and trend for this species are unknown. Populations from near Fort Bragg, Mendocino County may be varietally distinct (CNPS 2001). Historical occurrences need field surveys. This species is reported to be threatened by non-native plants and residential development. Impacts associated with timber harvest and recreation activities could affect this species through habitat modification and direct injury to plants.

***Juncus supiniformis*—hair-leaved rush**

Hair-leaved rush is a perennial, cespitose herb of the Rush family (Juncaceae). It is generally submerged when young and has matted many-branched rhizomes (Hickman 1993, Munz and Keck 1959). Stem nodes are often rooting (Hickman 1993, Hitchcock and Cronquist 1973). Leaves are much longer than the stems, submerged, less than 30 cm long, hair-like (approximately one mm wide), and have membranous sheath appendages (Hickman 1993, Munz and Keck 1959). Plants flower April to June as water recedes (CNPS 2001, Hickman 1993). Habitat includes marshes, ponds, ditches (Hickman 1993, Hitchcock and Cronquist 1973), Bogs and fens, ponds near coast, Closed-cone Pine forest (Munz and Keck 1959), and Marshes and Swamps (freshwater) near the coast (CNPS 2001). Elevations range from 20 to 100 meters (CNPS 2001).
Hair-leaved rush is known from Del Norte, Humboldt, and Mendocino counties and Oregon and other states. In Mendocino county, locations are recorded on the Fort Bragg (569A) and Mendocino (569D) USGS 7.5' quadrangles. It is not known from the JDSF.

Population status and trend for hair-leaved rush are unknown. Impacts to habitat likely include development, road construction and maintenance, and activities that significantly alter hydrologic conditions within watersheds. Activities associated with timber harvesting and road construction or maintenance could affect this species through habitat modification and direct injury to plants.

***Lasthenia macrantha* ssp. *bakeri*—Baker's goldfields**

Baker's goldfields is a perennial (rarely annual) herb in the Sunflower family (Asteraceae). Stems are erect and simple, sometimes few-branched, one to four dm tall (Hickman 1993, Munz and Keck 1959). Leaves are generally narrow (less than two mm), clustered in a basal rosette, and are generally gone before flowering. Inflorescences are radiate, having both ray and disk flowers. Ligules and disk flowers are generally yellow. Plants flower from April to October (CNPS 2001). Habitats include grasslands, woods near coast (Hickman 1993), Grassy forest openings, Closed-cone Pine Forest (Munz and Keck 1959), and Closed-cone coniferous forest (openings), and Coastal scrub (CNPS 2001). Elevations range from zero to 520 meters (CNPS 2001, Hickman 1993).

Baker's goldfields is known from Mendocino and Marin counties. It has been extirpated in Sonoma county. Baker's goldfields is known from the Albion (553A) [extirpated], Fort Bragg (569A), Gualala (537D) [extirpated], Mendocino (569D), Point Arena (537B), and Saunders Reef (537C) USGS 7.5' quadrangles in Mendocino county. No occurrences are known from the JDSF, but habitat is available for the species in the western portion of the property.

Population status and trend for Baker's goldfields are unknown. Activities associated with timber harvesting and road construction or maintenance could affect this species through habitat modification and direct injury to plants.

Lilium maritimum—coast lily

Coast lily in a perennial herbaceous plant in the lily family (Liliaceae). Plants are less than 2.5 dm with leaves basal, scattered, or in one to four whorls (Hickman 1993, Munz and Keck 1959). Leaves are generally dark green and oblanceolate to some-what linear with out a wavy margin. Flowers are bell-shaped and dark red to red-orange with darker spots concentrated mid-basally. Perianth segments are three to five cm and are strongly recurved in the upper one third. Plants flower May to July (CNPS 2001). Habitats include coastal prairie or scrub, bogs, gaps in closed-cone pine forest (Hickman 1993), northern coastal scrub and coniferous forests (Munz and Keck 1959), and Broadleaved upland forest, Closed-cone coniferous forest, Coastal prairie, Coastal scrub, Marshes and Swamps (freshwater), and North Coast coniferous forest (CNPS 2001). Elevation range includes five to 335 meters (CNPS 2001).
Coast lily is known from Mendocino, Marin, and Sonoma counties. It may also occur in San Francisco county, and it has been extirpated from San Mateo county. Coast lily is known from the Albion (553A), Comptche (568D), Elk (552B), Eureka Hill (537A), Fort Bragg (569A), Gualala (537D), Inglenook (585D), Mathison Peak (568C), Mendocino (569D), Noyo Hill (568B), Point Arena (537B), Saunders Reef (537C), and Westport (585A) USGS 7.5' quadrangles in Mendocino county. It is known from several locations on the JDSF.

Population status and trend for this species are unknown. Primary threats include road maintenance, urbanization, horticultural collecting, and habitat fragmentation (CNPS 2001). Impacts associated with timber harvest and recreation activities could affect this species through habitat modification and direct injury to plants. *L. maritimum* hybridizes with *L. pardalinum* ssp. *pardalinum*.

Lycopodium clavatum—running-pine

Running-pine is a creeping, decumbent perennial herb of the club-moss family (Lycopodiaceae). Stems are branching with small, scale-like, sterile leaves that are spirally arranged and often root at nodes or internodes. Plants reproduce by spores. Sporophylls are born on erect stems in strobili. Plants produce strobili July through August (CNPS 2001). Habitats include moist ground, swamps, rarely on trees (Hickman 1993), Douglas-fir forests (Munz and Keck 1959), moist coniferous woods and swamps (Hitchcock and Cronquist 1973), Marshes and Swamps, and mesic North Coast coniferous forest (CNPS 2001). Elevation range includes 60 to 790 meters (CNPS 2001).

Running-pine is known from Humboldt and Mendocino counties and is widespread outside of California. In Mendocino county, it is known from the Noyo Hill (568B) USGS 7.5' quadrangle and has been found on the JDSF. In 2000 it was found in a single location that straddles the Gualala and McGuire Ridge USGS 7.5' quadrangles; this occurrence has not yet been entered on the CNPS or CNDDB databases. Most California occurrences are in Humboldt county, and those in Mendocino may represent the limit of the southern range of the species.

Population status and trend are not known, but the species is considered threatened by timber harvest (CNPS 2001). Activities associated with timber harvesting and road construction or maintenance could affect this species through habitat modification and direct injury to plants.

***Mitella caulescens*—leafy-stemmed mitrewort**

Leafy-stemmed mitrewort is a perennial, rhizomatous herbaceous member of the saxifrage family (Saxifragaceae). Plants with basal rosette of round to cordate, shallowly three to seven lobed, toothed leaves that are two to seven cm wide (Hickman 1993, Munz and Keck 1959). Cauline leaves are similar in shape to basal leaves but are smaller. Flowers are yellow-green with a two to four mm wide hypanthium and bloom top to bottom from May through July (CNPS 2001, Hickman 1993, Munz and Keck 1959). This species is vegetatively similar to other members of the genus and must be seen in flower for positive identification. Habitats include wet shaded areas (Hickman 1993), moist shaded places in Yellow-pine and Douglas-fir forests (Munz and Keck 1959), and Marshes and Swamps, mesic North Coast coniferous forest (CNPS 2001). Elevations range from 60 to 790 meters (CNPS 2001).

Leafy-stemmed mitrewort is distributed in Del Norte, Humboldt, Mendocino, Siskiyou, and Tehama counties. It is more widespread outside of California. In Mendocino county, occurrences are recorded for the Dutchmans Knoll (584C), Elk (552B), Hales Grove (601D), Mathison Peak (568C), Mendocino (569D), and Navarro (552A) USGS 7.5' quadrangles. Leafy-stemmed mitrewort has been documented on the JDSF.

Population status and trend for the leafy-stemmed mitrewort are unknown, but the species may be threatened by timber harvest, urbanization, and road construction and maintenance. Activities associated with timber harvest may affect the species through habitat modification and direct injury to plants.

Navarretia leucocephala ssp. bakeri—Baker's navarretia

Baker's navarretia is an annual herb of the phlox family (Polemoniaceae). Stems are generally erect, spreading to ascending, two to 10 dm tall, and branched (Abrams 1951 Vol. III, Hickman 1993). Plants have recurved hairs. Lower leaves are linear and entire to few-toothed or pinnatifid with the upper leaves narrowly dissected and one to two pinnate. White to blue salverform flowers are one to two mm wide, four to 10 mm long, and have stamens and style exerted in head inflorescences. This species blooms May to July (CNPS 2001). Habitats include Vernal pools (Hickman 1993), vernal pools in meadows of the inner North Coast (Abrams 1951 Vol. III), Cismontane woodland, Lower montane coniferous forest, Meadows, Valley and foothill grassland, and Vernal pools (CNPS 2001). Elevation ranges from 15 to 1740 meters (CNPS 2001).

Baker's navarretia is known from Colusa, Lake, Mendocino, Marin, Napa, Solano, Sonoma, and Tehama counties (CNPS 2001). It is known from the Longvale (583C), Redwood Valley (566C), and Willits (567A) USGS 7.5' quadrangles in Mendocino county. It is not known from any locations on the JDSF.

Population status and trend for this species are unknown. Impacts associated with timber harvest and recreation activities could affect this species through habitat modification and direct injury to plants.

***Phacelia insularis* var. *continentis*—North Coast phacelia**

North Coast phacelia is an annual herb of the waterleaf family (Hydrophyllaceae). Stems are generally decumbent to ascending, short-stiff hairy, and glandular-puberulent (Hickman 1993). Leaves are 10 to 80 mm. Leaf blades are shorter than or equal in length to the petioles, oblong to elliptic, with lower leaves deeply lobed and upper leaves generally entire. Flowers are lavender to violet with five to eight mm bell-shaped petals. Plants bloom March to May (CNPS 2001). Habitats include Coastal bluff scrub and Coastal dunes / sandy (CNPS 2001) sandy soils, and bluffs (Hickman 1993). This species is generally found at less than 170 meters (CNPS 2001).

North Coast phacelia is known from Mendocino and Marin counties (CNPS 2001). It is known from the Fort Bragg (569A) and Inglenook (585D) USGS 7.5' quadrangles in Mendocino county. It is not known from any locations on the JDSF.

Population status and trend for this species are unknown. Impacts associated with timber harvest and recreation activities could affect this species through habitat modification and direct injury to plants.

***Pinus contorta* ssp. *bolanderi*— Bolander's beach pine**

Bolander's beach pine is a small, evergreen, closed-cone, coniferous tree in the pine family (Pinaceae). The trunk is typically less than two meters high (Hickman 1993). This subspecies is found in closed-cone coniferous forest, in podzolized soils (CNPS 2001), below 250 meters elevation (Hickman 1993).

Bolander's beach pine is found only in Mendocino County, within the Albion (553A), Elk (552B), Fort Bragg (569A), Mathison Peak (568C), Mendocino (569D), and Noyo Hill (568B) USGS 7.5' Quadrangles (CNPS 2001). This species has been recorded both within and outside of JDSF in the Western and Southern WWAAs.

The current population status and trend are uncertain, but Bolander's beach pine is considered at risk to development and vehicles (CNPS 2001). Activities associated with timber harvesting and road construction or maintenance could affect this species through habitat modification and direct injury to plants. Long-term suppression of fire decreases recruitment of young trees by allowing build-up of leaf litter and debris on the ground, thereby reducing successful germination and seedling establishment Frequent stand-replacing fires may eliminate Bolander's beach pine groves entirely if fire returns at an interval shorter than that required for young trees to produce seed-bearing cones.

***Pleuropogon hooverianus*—North Coast semaphore grass**

North Coast semaphore grass is a member of the grass family (Poaceae). It has large, long (one to three dm), flat (five to seven mm wide), ribbon-like leaves and a raceme of widely-spaced spikelets (CDFG 1992c, Hitchcock and Chase 1971). The blooming period is May through August (CNPS 2001). This species is found in Broadleaved upland forest, Meadows, Marshes and Swamps (freshwater), North Coast coniferous forest, and Vernal pools / mesic (CNPS 2001). Elevation range includes 10 to 635 meters (CNPS 2001).

North Coast semaphore grass is known to occur in Marin, Sonoma, and Mendocino Counties (CDFG 1997). As many as 12 occurrences were previously identified (prior to the release of the CNPS 6th Inventory of Rare Plants), but surveys in the early 1990's failed to find the species at many of the sites (CDFG 1992c; CNPS 2001). In Mendocino County it is known from the Boonville (551D), Cahto Peak (584A), Comptche (568D), Elledge Peak (550C), Hopland (535A), Laytonville (583B), Longvale (583C), Orrs Springs (551A), Willits (567A) USGS 7.5' quadrangles (CNPS 2001). North Coast Semaphore grass has not been recorded in the JDSF.

Populations of North Coast semaphore grass are believed to be declining (CDFG 1992c). This species is reported as being threatened by roadside maintenance (CNPS 2001). Loss of habitat and disruption of natural hydrologic conditions due to development have been implicated in population declines of this species (CDFG 1992a). Activities associated with timber harvesting and road construction or maintenance could affect this species through habitat modification, habitat changes due to altered hydrologic regimes, and direct injury to plants. Study is needed for adequate conservation management.

***Rhynchospora alba*—white beaked-rush**

White beaked-rush is a rhizomatous perennial herb in the sedge family (Cyperaceae). Plants are generally one to seven dm tall with triangular erect stems (Munz and Keck 1959). Leaves are linear and sheathing. Inflorescences consist of one to four axillary capitate clusters of six to 20 spikelets. Spikelets are oblong, acute at both ends, four to six mm long, and contain sterile, staminate, and bisexual flowers. Flowers have 10 to 12 perianth bristles that are stiff, downwardly barbed, and about as long as the achenes. Plants flower from July to August (CNPS 2001). Habitats include Bogs and fens, Meadows, Marshes and Swamps (CNPS 2001), Yellow Pine Forest, Mixed Evergreen Forest, and Northern Coastal Scrub (Munz and Keck 1959). Elevation range includes 60 to 2040 meters (CNPS 2001).

White beaked-rush is known from Del Norte [?], Inyo [?], Lassen, Mendocino, Mariposa [?], Nevada [?], Plumas, Sonoma, and Trinity counties and is widespread outside of California (CNPS 2001). It is known from the Fort Bragg (569A), Inglenook (585D), Mathison Peak (568C), and Mendocino (569D) USGS 7.5' quadrangles in Mendocino county. It is not known from any locations on the JDSF.

Population status and trend for this species are unknown. Impacts associated with timber harvest and recreation activities could affect this species through habitat modification and direct injury to plants.

***Sanguisorba officinalis*—great burnet**

Great burnet is a rhizomatous perennial herb in the rose family (Rosaceae). Plants are generally 50 to 140 cm tall with erect stems (Hickman 1993). Leaves are alternate, once odd-pinnate, and have 3 to 6 toothed leaflets per side. The largest leaflet blade is 25 to 50 cm and ovate –oblong. Inflorescences are generally 12 to 20 mm long, seven to 10 mm wide, elliptic-ovoid, and have more than 20 flowers. Sepals are dark purplish and two to 3.5 mm long. Plants flower from July to October (CNPS 2001). Habitats include Bogs and fens, Broadleaved upland forest, Meadows, Marshes and Swamps, North Coast coniferous forest, Riparian forest / often serpentinite (CNPS 2001), and streams (Hickman 1993). Elevation range includes 60 to 1400 meters (CNPS 2001).

Great burnet is known from Del Norte, Humboldt, and Mendocino counties and is widespread outside of California (CNPS 2001). It is known from the Albion (553A), Cahto Peak (584A), Laytonville (583B), Longvale (583C), Mendocino (569D), and Ukiah (550B) USGS 7.5' quadrangles in Mendocino county. It is not known from any locations on the JDSF.

Population status and trend for this species are unknown. Impacts associated with timber harvest and recreation activities could affect this species through habitat modification and direct injury to plants.

***Senecio bolanderi* ssp. *bolanderi*—seacoast ragwort**

Seacoast ragwort is a rhizomatous perennial herb in the sunflower family (Asteraceae). Plants are one to five dm tall and are glabrous or nearly so (Hickman 1993, Munz and Keck 1959). Basal leaves are approximately one to three cm, round-cordate or subcordate, and generally palmately lobulate with toothed lobes; cauline leaves are also lobed and reduced upwards (Hickman 1993, Munz and Keck 1959). Inflorescences have radiate heads with yellow flowers. Plants flower from June to July (CNPS 2001). Habitats include Coastal scrub, North Coast coniferous forest (CNPS 2001), wet cliffs, and open forest (Hickman 1993). Elevation range includes 30 to 650 meters (CNPS 2001).

Seacoast ragwort is known from Del Norte, Humboldt, and Mendocino counties and is also known from Oregon and Washington. It is known from the Mendocino (569D) USGS 7.5' quadrangle in Mendocino county. It is not known from any locations on the JDSF.

Population status and trend for this species are unknown. Impacts associated with timber harvest and recreation activities could affect this species through habitat modification and direct injury to plants.

***Sidalcea calycosa* ssp. *rhizomata*—Point Reyes checkerbloom**

Point Reyes checkerbloom is a rhizomatous perennial herb in the mallow family (Malvaceae). Plants have erect or ascending succulent stems, 3 to 5 dm high, and are glabrous or minutely hirsute above (Munz and Keck 1959). Basal leaves are three to 10 cm wide, shallowly incised, and cauline leaves are divided into seven to 11 broadly cuneate divisions. This subspecies is apparently easily distinguished from others by its large,fused, ciliate bracts (Hickman 1993). Plants flower from April to September (CNPS 2001). Habitats include Marshes and Swamps (freshwater, near coast; Hickman 1993) and among tussocks of sedge and rush (Munz and Keck 1959). Elevation range includes three to 75 meters (CNPS 2001).

Point Reyes checkerbloom is known from Mendocino, Marin, and Sonoma counties (CNPS 2001). It is known from the Albion (553A), Elk (552B), and Saunders Reef (537C) USGS 7.5' quadrangles in Mendocino county. It is not known from any locations on the JDSF.
Population status and trend for this species are unknown. Impacts associated with timber harvest and recreation activities could affect this species through habitat modification and direct injury to plants.

***Sidalcea malachroides*—maple-leaved checkerbloom**

Maple-leaved checkerbloom is a perennial or subshrub in the mallow family (Malvaceae). Plants arise from a woody caudex and are harshly bristly and stellate throughout (Hickman 1993). Leaf blades, which are coarsely dentate, are often described as grape-like and can be confused with pink-flowering currant (*Ribes sanguineum* var. *glutinosum*) or thimbleberry (*Rubus parviflorus*) leaves. Flowers can be bisexual, staminate, or pistillate, and plants can have flowers of all one type or be mixed. Flowers have white or purple-tinged petals and are densely clustered in many-branched panicles. Plants flower from April to August (CNPS 2001). Habitats include Broadleaved upland forest, Coastal prairie, Coastal scrub, North Coast coniferous forest / often in disturbed areas (CNPS 2001), and woodlands and clearings near the coast (Hickman 1993). Elevation range includes two to 700 meters (CNPS 2001).

Maple-leaved checkerbloom is known from Del Norte, Humboldt, Mendocino, Monterey, Santa Clara, Santa Cruz, and Sonoma counties, and it has been extirpated in Oregon (CNPS 2001). It is known from the Albion (553A), Bear Harbor (601B), Comptche (568D), Dutchmans Knoll (584C), Gualala (537D), Inglenook (585D), Mallo Pass Creek (552C), Noyo Hill (568B), Point Arena (537B), Westport (585A) USGS 7.5' quadrangles in Mendocino county. It is not known from any locations on the JDSF.

Population status and trend for this species are unknown. Impacts associated with timber harvest and recreation activities could affect this species through habitat modification and direct injury to plants. Maple-leaved checkerbloom is a colonizing spcies. In Humboldt County this species has been observed growing along dirt roads, skid trails, forest openings, and forest margins. It is infrequently found in heavily vegetated areas. It may be a colonizer of disturbed soils that is eventually shaded out. Study is needed for adequate conservation management.

***Sidalcea malviflora* ssp. *purpurea*— Point Reyes checkerbloom**

Point Reyes checkerbloom is a rhizomatous perennial herb in the mallow family (Malvaceae). Plants are more or less purple-tinted, especially at the base, stipules, and calyx, and are less than 6 dm with simple leaves (Hickman 1993). Lowest leaves are coarsely crenate, unlobed, less than two cm wide, and (all leaves are) bristly on both sides. The calyx is sparsely fine-stellate with some coarser bristles. Plants flower in May (CNPS 2001). Habitats include Broadleaved upland forest and Coastal prairie from 15 to 65 meters in elevation (CNPS 2001) and open coastal forest at less than 50 meters in elevation (Hickman 1993).

Point Reyes checkerbloom is known from Mendocino, Marin [?], San Mateo, and Sonoma counties (CNPS 2001). It is known from the Fort Bragg (569A) USGS 7.5' quadrangle in Mendocino county. It is not known from any locations on the JDSF.

Population status and trend for this species are unknown. Impacts associated with timber harvest and recreation activities could affect this species through habitat modification and direct injury to plants. Study is needed for adequate conservation management.

***Triquetrella californica*— N/A**

This moss is in the Pottiaceae. Habitats include Coastal bluff scrub and Coastal scrub / soil (CNPS 2001).

It is known from Contra Costa, Mendocino, San Diego, and San Francisco counties and is also known from Oregon (CNPS 2001). In Mendocino County it is known from the Inglenook (585D) USGS 7.5' quadrangle. It is not known from any locations on the JDSF.

Population status and trend for this species are unknown. Known in CA from fewer than ten small coastal occurrences and in Oregon from only one occurrence (CNPS 2001). Threatened by urbanization. Impacts associated with timber harvest and recreation activities could affect this species through habitat modification and direct injury to plants.

***Viola palustris*— marsh violet**

Marsh violet is a rhizomatous perennial herbaceous plant in the violet family (Violaceae). Plants are glabrous with simple basal leaves (Hickman 1993). Leaves are round-cordate to –ovate, slightly crenulate, two to 6.5 cm wide (Hickman 1993, Munz and Keck 1959). Petals are almost white to pale blue or violet with the lowest (including spur) being eight to 17 mm (Hickman 1993). The lower three petals are violet-veined at the base, and the two lateral petals are more or less bearded. Plants flower March to August (CNPS 2001). Habitats include Coastal scrub (mesic), Bogs and fens (coastal; CNPS 2001), and swampy, shrubby places (Hickman 1993).

Marsh violet is known from Del Norte, Humboldt, and Mendocino counties and is widespread outside of California (CNPS 2001). Marsh violet is known from the Fort Bragg (569A) USGS 7.5' quadrangle in Mendocino county. It is not known from any locations on the JDSF.

Population status and trend for this species are unknown. Known in CA from only four occurrences, it is often overlooked and rarely collected (CNPS 2001). Impacts associated with timber harvest and recreation activities could affect this species through habitat modification and direct injury to plants.

Guidelines for Assessing the Effects of Proposed Projects on Rare, Threatened, and Endangered Plants and Natural Communities

State of California
THE RESOURCES AGENCY
Department of Fish and Game
December 9, 1983
Revised May 8, 2000

The following recommendations are intended to help those who prepare and review environmental documents determine **when** a botanical survey is needed, **who** should be considered qualified to conduct such surveys, **how** field surveys should be conducted, and **what** information should be contained in the survey report. The Department may recommend that lead agencies not accept the results of surveys that are not conducted according to these guidelines.

1. Botanical surveys are conducted in order to determine the environmental effects of proposed projects on all rare, threatened, and endangered plants and plant communities. Rare, threatened, and endangered plants are not necessarily limited to those species which have been "listed" by state and federal agencies but should include any species that, based on all available data, can be shown to be rare, threatened, and/or endangered under the following definitions:

   A species, subspecies, or variety of plant is "endangered" when the prospects of its survival and reproduction are in immediate jeopardy from one or more causes, including loss of habitat, change in habitat, over-exploitation, predation, competition, or disease. A plant is "threatened" when it is likely to become endangered in the foreseeable future in the absence of protection measures. A plant is "rare" when, although not presently threatened with extinction, the species, subspecies, or variety is found in such small numbers throughout its range that it may be endangered if its environment worsens.

   Rare natural communities are those communities that are of highly limited distribution. These communities may or may not contain rare, threatened, or endangered species. The most current version of the California Natural Diversity Database's List of California Terrestrial Natural Communities may be used as a guide to the names and status of communities.

2. It is appropriate to conduct a botanical field survey to determine if, or to the extent that, rare, threatened, or endangered plants will be affected by a proposed project when:

   a. Natural vegetation occurs on the site, it is unknown if rare, threatened, or endangered plants or habitats occur on the site, and the project has the potential for direct or indirect effects on vegetation; or
   b. Rare plants have historically been identified on the project site, but adequate information for impact assessment is lacking.

3. Botanical consultants should possess the following qualifications:

   a. Experience conducting floristic field surveys;
   b. Knowledge of plant taxonomy and plant community ecology;
   c. Familiarity with the plants of the area, including rare, threatened, and endangered species;
   d. Familiarity with the appropriate state and federal statutes related to plants and plant collecting; and,
   e. Experience with analyzing impacts of development on native plant species and communities.

4. Field surveys should be conducted in a manner that will locate any rare, threatened, or endangered species that may be present. Specifically, rare, threatened, or endangered plant surveys should be:

   a. Conducted in the field at the proper time of year when rare, threatened, or endangered species are both evident and identifiable. Usually, this is when the plants are flowering.

When rare, threatened, or endangered plants are known to occur in the type(s) of habitat present in the project area, nearby accessible occurrences of the plants (reference sites) should be observed to determine that the species are identifiable at the time of the survey.

b. Floristic in nature. A floristic survey requires that every plant observed be identified to the extent necessary to determine its rarity and listing status. In addition, a sufficient number of visits spaced throughout the growing season are necessary to accurately determine what plants exist on the site. In order to properly characterize the site and document the completeness of the survey, a complete list of plants observed on the site should be included in every botanical survey report.

c. Conducted in a manner that is consistent with conservation ethics. Collections (voucher specimens) of rare, threatened, or endangered species, or suspected rare, threatened, or endangered species should be made only when such actions would not jeopardize the continued existence of the population and in accordance with applicable state and federal permit requirements. A collecting permit from the Habitat Conservation Planning Branch of DFG is required for collection of state-listed plant species. Voucher specimens should be deposited at recognized public herbaria for future reference. Photography should be used to document plant identification and habitat whenever possible, but especially when the population cannot withstand collection of voucher specimens.

d. Conducted using systematic field techniques in all habitats of the site to ensure a thorough coverage of potential impact areas.

e. Well documented. When a rare, threatened, or endangered plant (or rare plant community) is located, a California Native Species (or Community) Field Survey Form or equivalent written form, accompanied by a copy of the appropriate portion of a 7.5 minute topographic map with the occurrence mapped, should be completed and submitted to the Natural Diversity Database. Locations may be best documented using global positioning systems (GPS) and presented in map and digital forms as these tools become more accessible.

5. Reports of botanical field surveys should be included in or with environmental assessments, negative declarations and mitigated negative declarations, Timber Harvesting Plans (THPs), EIR's, and EIS's, and should contain the following information:

a. Project description, including a detailed map of the project location and study area.
b. A written description of biological setting referencing the community nomenclature used and a vegetation map.
c. Detailed description of survey methodology.
d. Dates of field surveys and total person-hours spent on field surveys.
e. Results of field survey including detailed maps and specific location data for each plant population found. Investigators are encouraged to provide GPS data and maps documenting population boundaries.
f. An assessment of potential impacts. This should include a map showing the distribution of plants in relation to proposed activities.
g. Discussion of the significance of rare, threatened, or endangered plant populations in the project area considering nearby populations and total species distribution.
h. Recommended measures to avoid impacts.
i. A list of all plants observed on the project area. Plants should be identified to the taxonomic level necessary to determine whether or not they are rare, threatened or endangered.
j. Description of reference site(s) visited and phenological development of rare, threatened, or endangered plant(s).
k. Copies of all California Native Species Field Survey Forms or Natural Community Field Survey Forms.
l. Name of field investigator(s).
j. References cited, persons contacted, herbaria visited, and the location of voucher specimens.

APPENDIX 8D-3
CALIFORNIA NATIVE PLANT SOCIETY'S
INVENTORY OF RARE AND ENDANGERED PLANTS OF CALIFORNIA
SELECTED CNPS PLANTS BY SCIENTIFIC NAME
JDSF - PROJECT AND ADJACENT
RATIONALE FOR INCLUSION OF SPECIES FOR CONSIDERATION ON JDSF OWNERSHIP

Scientific/Common Name	CNPS	R-E-D	State	Federal	Decision and Rationale
ABRONIA UMBELLATA SSP. BREVIFLORA "pink sand-verbena"	1B	2-3-2	None	None	Unlikely (restricted to coast)
AGROSTIS BLASDALEI "Blasdale's bent grass"	1B	3-2-3	None	None	Unlikely (coastal prairie, coastal dunes, coastal bluff scrub)
ALISMA GRAMINEUM "narrow-leaved water-plantain"	2	3-2-1	None	None	Watch for (ponds, ditches, freshwater marshes and swamps at 390 to 1800 meters)
ARCTOSTAPHYLOS MENDOCINOENSIS "pygmy manzanita"	1B	3-2-3	None	None	Known
ARENARIA PALUDICOLA "marsh sandwort"	1B	3-3-2	CE	FE	Likely
ASTRAGALUS AGNICIDUS "Humboldt milk-vetch"	1B	3-3-3	CE	None	Known
BLENNOSPERMA NANUM VAR. ROBUSTUM "Point Reyes blennosperma"	1B	3-2-3	CR	None	Unlikely (coastal prairie, dunes)
CALAMAGROSTIS BOLANDERI "Bolander's reed grass"	1B	-2-3	None	None	Known
CALAMAGROSTIS CRASSIGLUMIS "Thurber's reed grass"	2	3-3-1	None	None	Watch for (species habitat includes marshes and swamps; not known to occur over 45 meters in elevation)
CAMPANULA CALIFORNICA "swamp harebell"	1B	2-2-3	None		Known
CARDAMINE PACHYSTIGMA VAR. DISSECTIFOLIA "dissected-leaved toothwort"	3	?-?-3	None	None	Watch for (CNPS list 3; habitat includes chaparral and lower montane coniferous forest/serpentine, rocky)
CAREX ARCTA "northern clustered sedge"	2	2-2-1	None	None	Likely
CAREX CALIFORNICA "California sedge"	2	3-1-1	None	None	Known
CAREX LIVIDA "livid sedge"	1A	*	None	None	Unlikely (known from one collection in Mendocino County but considered extirpated from CA)
CAREX LYNGBYEI "Lyngbye's sedge"	2	2-2-1	None	None	Unlikely (immediate coast)
CAREX SALINIFORMIS "deceiving sedge"	1B	2-2-3	None	None	Likely

Scientific/Common Name	CNPS	R-E-D	State	Federal	Decision and Rationale
CAREX VIRIDULA VAR. VIRIDULA "green sedge"	2	3-1-1	None	None	Likely
CASTILLEJA AFFINIS SSP. LITORALIS "Oregon coast Indian paintbrush"	2	2-2-1	None	None	Watch for (habitat includes coastal bluff scrub, coastal dunes, coastal scrub/sandy)
CASTILLEJA AMBIGUA SSP. HUMBOLDTIENSIS "Humboldt Bay owl's-clover"	1B	2-2-3	None		Unlikely (coastal salt marshes and swamps)
CASTILLEJA MENDOCINENSIS "Mendocino coast Indian paintbrush"	1B	2-2-3	None	None	Unlikely (coastal occurrences in coastal bluff scrub, closed-cone coniferous forest, coastal dunes, prairie, and scrub)
CHORIZANTHE HOWELLII "Howell's spineflower"	1B	3-2-3	CT	FE	Unlikely (coastal dunes, prairie, and scrub/sandy)
CLARKIA AMOENA SSP. WHITNEYI "Whitney's farewell-to-spring"	1B	3-3-3	None	None	Unlikely (coastal bluff scrub, coastal scrub)
COLLINSIA CORYMBOSA "round-headed chinese houses"	1B	2-2-3	None	None	Unlikely (coastal dunes)
CUPRESSUS GOVENIANA SSP. PIGMAEA "pygmy cypress"	1B	2-2-3	None	None	Known
ERIGERON SUPPLEX "supple daisy"	1B	3-2-3	None	None	Unlikely (coastal bluff scrub, coastal prairie)
ERYSIMUM MENZIESII SSP. MENZIESII "Menzies's wallflower"	1B	3-3-3	CE	FE	Unlikely (coastal dunes
ERYTHRONIUM REVOLUTUM "coast fawn lily"	2	2-2-1	None	None	Likely
FRITILLARIA RODERICKII "Roderick's fritillary"	1B	3-3-3	CE	None	Likely
GILIA CAPITATA SSP. PACIFICA "Pacific gilia"	1B	2-2-2	None	None	Unlikely (coastal bluff scrub, coastal prairie)
GILIA MILLEFOLIATA "dark-eyed gilia"		1B	2-2-2	None	Unlikely (coastal dunes)
HEMIZONIA CONGESTA SSP. LEUCOCEPHALA "Hayfield tarplant"	3	?-?-3	None	None	Watch for (CNPS list 3; coastal scrub, valley and foothill grassland)
HESPEREVAX SPARSIFLORA VAR. BREVIFOLIA "short-leaved evax"	2	2-2-1	None	None	Unlikely (coastal bluff scrub, coastal dunes)
HESPEROLINON ADENOPHYLLUM "glandular western flax"	1B	2-2-3	None	None	Unlikely (chaparral, cismontane woodland, valley and foothill grasslands/serpentine)
HORKELIA MARINENSIS "Point Reyes horkelia"	1B	3-2-3	None	None	Likely
JUNCUS SUPINIFORMIS "hair-leaved rush"	2	2-2-2	None	None	Likely
LASTHENIA MACRANTHA SSP. BAKERI "Baker's goldfields"	1B	2-2-3	None	None	Likely
LASTHENIA MACRANTHA SSP.	1B	2-2-3	None	None	Unlikely (coastal scrub, dunes,

Scientific/Common Name	CNPS	R-E-D	State	Federal	Decision and Rationale
MACRANTHA "perennial goldfields"					and bluff scrub, coastal strand)
LILIUM MARITIMUM "coast lily"	1B	2-3-3	None	None	Known
LIMNANTHES BAKERI "Baker's meadowfoam"	1B	3-3-3	CR	None	Unlikely (vernal pools; known distribution is over ridge from JDSF)
LYCOPODIUM CLAVATUM "running-pine"	2	2-1-1	None	None	Likely
MICROSERIS BOREALIS "northern microseris"	2	3-3-1	None	None	Unlikely (bogs and fens, lower montane coniferous forest, meadows/mesic; 1000 to 2000 meters elevation)
MITELLA CAULESCENS "leafy-stemmed mitrewort"	2	2-1-1	None	None	Known
NAVARRETIA LEUCOCEPHALA SSP. BAKERI "Baker's navarretia"	1B	2-3-3	None	None	Likely
PHACELIA ARGENTEA "sand dune phacelia"	1B	3-3-2	None	None	Unlikely (coastal dunes)
PHACELIA INSULARIS VAR. CONTINENTIS "North Coast phacelia"	1B	3-2-3	None	None	Likely
PINUS CONTORTA SSP. BOLANDERI "Bolander's beach pine"	1B	2-2-3	None	None	Known
PLEUROPOGON HOOVERIANUS "North Coast semaphore grass"	1B	3-3-3	CR	None	Likely
POTAMOGETON EPIHYDRUS SSP. NUTTALLII "Nuttall's pondweed"	2	2-2-1	None	None	Watch for (freshwater marshes and swamps)
PUCCINELLIA PUMILA "dwarf alkali grass"	2	3-2-1	None	None	Unlikely (coastal salt marshes and swamps)
RHYNCHOSPORA ALBA "white beaked-rush"	2	2-2-1	None	None	Likely
SANGUISORBA OFFICINALIS "great burnet"	2	2-2-1	None	None	Likely
SENECIO BOLANDERI VAR. BOLANDERI "seacoast ragwort"	2	2-2-1	None	None	Likely
SIDALCEA CALYCOSA SSP. RHIZOMATA "Point Reyes checkerbloom"	1B	2-2-3	None	None	Likely
SIDALCEA MALACHROIDES "maple-leaved checkerbloom"	1B	2-2-2	None	None	Likely
SIDALCEA MALVIFLORA SSP. PURPUREA "purple-stemmed checkerbloom"	1B	2-2-3	None		Likely
TRIQUETRELLA CALIFORNICA "n/a"	1B	3-2-2	None	None	Likely
VIBURNUM ELLIPTICUM "oval-leaved viburnum"	2	2-1-1	None	None	Unlikely (chaparral, cismontane woodland, lower montane coniferous forest, occurrences generally well inland)
VIOLA PALUSTRIS "marsh violet"	2	3-2-1	None	None	Likely

Appendix 8D-4
Potential Resources for Species Accounts

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APPENDIX 8E
WILDLIFE—SENSITIVE SPECIES LISTS

TABLE A SENSITIVE SPECIES ADDRESSED AND AMOUNT OF POTENTIAL HABITAT ON JDSF	
Species	**JDSF**
Lotis blue butterfly	2 bogs (Acres not quantified)
Southern torrent salamander	186 miles (Class II watercourses)
Tailed frog	186 miles (Class II watercourses)
Northern red-legged frog	
Aquatic	284 miles (Class I and CII watercourses and ponds)
Foothill yellow-legged frog	284 miles (Class I and CII watercourses and ponds)
Northwestern pond turtle	
Upland	3,476 acres
Aquatic	284 miles (Class I and II watercourses, and ponds)
Northern goshawk	
Nesting	1,883 acres
Foraging	39,389 acres
Cooper's hawk	
Nesting	2,508 acres
Foraging	46,143 acres
Golden eagle	
Nesting	15,427 acres
Foraging	958 acres
Bald eagle	
Nesting/Roosting	35,674 acres
Aquatic	98 miles (Class I watercourses)
Osprey	
Nesting	42,893 acres
Aquatic	98 miles (Class I watercourses)
Peregrine falcon	
Nesting	0 (No suitable cliffs located on JDSF)
Foraging	3,539 acres
Marbled murrelet	459 acres of old-growth and numerous scattered residuals
Northern spotted owl	
Nesting/Roosting	17,138 acres
Foraging	6,176 acres
Vaux's swift	38,741 acres
Purple martin	31,047 acres
Yellow Warbler	
Nesting	64 acres
Foraging	19,191 acres
Olive-sided flycatcher	
Nesting	40,688 acres
California red tree vole	38,741 acres
Pacific fisher	
Resting/Denning	17,138 acres
Foraging	6,176 acres

TABLE B
SUMMARY OF MARBLED MURRELET SURVEYS CONDUCTED IN JDSF BETWEEN 1993 AND 2001
(All surveys were conducted in the breeding season unless otherwise noted).

Year	Location	Done to protocol?	Specific Survey Date(s)	No. of Stations	Surveyor(s) (if different than cited in Source)	Detections ?	Source
1993-1994	Noyo Hill	Unknown	7/17/93, 5/15/93, 7/23/93, 6/10/94, 6/29/93, 6/30/94, 8/4/93, 7/8/94	4 (8 visits)	Unknown	None	Cota and Papke 1994
1993-1994	Chamberlain Creek	Unknown	7/7/93, 7/18/93, 5/14/94, 7/24/93, 6/12/94, 7/30/94, 7/11/94, 7/3/94	4 (8 visits)	Unknown	None	Cota and Papke 1994
1993–1994	Mendocino Woodlands	Unknown	7/8/93, 5/16/94, 7/17/93, 7/23 and 7/29 (Incomplete record)	4 (8 visits)	Unknown	None	Cota and Papke 1994
1993–1994	Brandon Gulch	Yes	7/16/93, 7/23/94, 5/15/94, 8/5/93, 6/9/94, 7/10/94, 7/1/94, 7/29/93	4 (8 visits)	Unknown	None	Cota and Papke 1994
1996	NF SF Noyo River	Yes	7/13, 7/22, 7/29, 8/5	4	Unknown	None	CDFG 1996
1996	McGuire/Dunlap Grove	No	7/16, 7/24, 7/30, 8/6	4	Unknown	None	CDFG 1996
1996	Dresser Grove	Yes	7/12, 7/18, 7/25, 8/1	4	unknown	None	CDFG 1996
1996	Waterfall Grove	Yes	7/15, 7/23, 7/31, 8/7	4	unknown	None	CDFG 1996
1997	Hilo-off Road 1070	Unknown	7/2, 7/7, 7/21, 7/28	4	Unknown	None	CDFG 1997
1997	Waterfall Extension	Unknown	7/24, 8/1, 8/7	3	Unknown	None	CDFG 1997
1997	Waterfall Grove	Yes	6/30, 7/10, 7/15, 7/24	4	Unknown	None	CDFG 1997
1997	Dresser Grove	Yes	7/03, 7/08, 7/16, 7/31	4	Unknown	None	CDFG 1997
1997	NFSF Noyo River	Yes	7/1, 7/14, 7/25, 7/29	4	Unknown	None	CDFG 1997

TABLE B
SUMMARY OF MARBLED MURRELET SURVEYS CONDUCTED IN JDSF BETWEEN 1993 AND 2001
(All surveys were conducted in the breeding season unless otherwise noted).

Year	Location	Done to protocol?	Specific Survey Date(s)	No. of Stations	Surveyor(s) (if different than cited in Source)	Detections ?	Source
1998	HiLo- Southern patch	Yes	5/28, 6/25, 7/20, 7/27	4	Unknown	None	CDFG 1998
1998	HiLo-Northern Patch	Yes	5/27, 6/26, 7/21, 7/28	4	Unknown	None	CDFG 1998
1998	NFSF Noyo Old-Growth	Yes	6/5, 6/24, 7/24, 7/31	4	Unknown	None	CDFG 1998
1999	Lower Hare Creek	Yes	5/28, 6/24, 7/14, 7/21	4	Unknown	None	CDFG 1999a
1999	Upper Parlin THP	Yes	6/1, 6/22, 7/7, 7/26	4	Unknown	None	CDFG 1999a
1999	Camp 3 Old-Growth	Yes	6/3, 6/30, 7/08, 7/29	4	Unknown	None	CDFG 1999a
1999	NFSF Noyo Old-Growth	Yes	6/4, 6/29, 7/19, 7/27	4	Unknown	None	CDFG 1999a
2000	Lower Hare Creek THP	Yes	7/7, 7/20, 6/11, 6/7	4	Pam Town/ Janet Stein	None	Town 2000b
2000	Upper Parlin THP	Yes	7/21, 6/26, 7/14, 6/19	4	Pam Town/ Janet Stein	None	Town 2000b
2000	HiLo THP	Yes	7/8, 7/17, 5/5, 6/11, 5/12, 5/10, 7/22, 7/11,6/8	4	Pam Town/ Janet Stein	None	Town 2000b
2000	NF SF Noyo	Yes	7/18, 5/11, 6/25, 7/6	4	Pam Town/ Janet Stein	None	Town 2000b
2001	Lower Hare THP-Digger Creek	Yes	5/28, 6/23, 7/06, 7/14, 7/21, 7/27, 8/01	6	Pam Town/ Janet Stein	two possible (7/21/01)	Town 2001
2001	Noyo Old-Growth	Yes	5/25, 6/22, 7/7, 7/19, 8/03	5	Pam Town/ Janet Stein	None	Town 2001
2001	Upper Parlin THP	Yes	5/23, 6/19, 7/09, 7/20, 7/28	5	Pam Town/ Janet Stein	None	Town 2001

TABLE B
SUMMARY OF MARBLED MURRELET SURVEYS CONDUCTED IN JDSF BETWEEN 1993 AND 2001
(All surveys were conducted in the breeding season unless otherwise noted).

Year	Location	Done to protocol?	Specific Survey Date(s)	No. of Stations	Surveyor(s) (if different than cited in Source)	Detections ?	Source
2001	Waterfall Grove	Yes	5/26, 6/22, 7/13, 7/23,7/30	5	Pam Town/ Janet Stein	None	Town 2001

[a] No USFWS protocol was available at this time.

[b] Initial survey followed protocol that was current at that time. Only one year was completed.

[c] Standard protocol guidelines set forth by the Pacific Seabird Group, Marbled Murrelet Technical Committee (Ralph et al., 1994), and endorsed by USFWS, specify two consecutive years of intensive surveys.

[d] Protocol described in Ralph et al. (1993).

[e] No information was available regarding which station was surveyed on each date.

TABLE C SUMMARY OF NORTHERN SPOTTED OWL SURVEYS COMPLETED ON JDSF 1990-2001					
Year	**Survey Summary**	**Surveyors**	**Protocol?**	**Banding?**	**Source**
2001	Entire JDSF ownership surveyed.	NCASI	Yes	Yes	Stephens 2002
2000	Monitoring of 16 known territories and surveys for THPs.	P. Town, NCASI, Campbell Group, MRC	Yes	Yes, radio telemetry	Town 2000b
1999	Monitoring of 16 known territories and surveys for THPs.	P. Town, TTC, MRC, and others	Yes	Yes	CDFG 1999a
1998	Monitoring of 15 known territories and surveys for THPs.	P. Town, G-P, MRC, and others	Yes	No	CDFG 1998
1997	Monitoring of 15 known territories and surveys for THPs.	P. Town, G-P, L-P, and others	Yes	Yes (limited)	CDFG 1997
1996	Monitoring of 13 known territories and surveys for THPs	Pamela Town, CDFG, G-P, and JDSF staff	Yes	No	CDFG 1996
1994–1995	Monitoring of known territories and surveys for THPs.	RMI staff, Jones and Stokes (1994)	Yes	Yes (1994)	RMI 1996
1993	Approximately 90% of JDSF surveyed.	CDFG, G-P, and others	Yes	Yes	Roberts et al. 1993
1992	Approximately 90% of JDSF surveyed.	CDFG, G-P, and others	Yes	Yes	Roberts et al. 993
1991	Approximately 90% of JDSF surveyed.	CDFG, G-P, and others	Yes	Yes	Roberts et al. 1993

TABLE D
NORTHERN SPOTTED OWL TERRITORIES AND PRODUCTIVITY ON JDSF BETWEEN 1995 AND 2001

Territory Name	Yr. Found	CDFG #	2001	2000	1999	1998	1997	1996	1995
Brandon Gulch	2001	MD551	M (new site)	N/A	N/A	N/A	N/A	N/A	N/A
Frolic	2001	MD550	N, 1Y (new site)	N/A	N/A	N/A	N/A	N/A	N/A
Parlin	Pre 1995	MD311	P	X	X	X	X	SNC	X
Peterson Gulch	Pre 1995	MD523	N, 1F	N, 2F	P	P	SNC	SNC	SNC
Soda Gulch	1996	MD516	X	SNC	SNC	SNC	SNC	M, I	SNC
Bear Gulch	1997	N/A	SNC	SNC	SNC	SNC	I	N/A	N/A
Camp 3	Pre 1995	MD163	N, 1F	N, 1F	N, 1F	P	P	N, 1Y	X
Deadman's Trestle	Pre 1995	MD237	N, 2F	N, 2Y	N, 0Y	N, 0Y	N, 0Y	N, 1Y	P
NF of SF Noyo River	Pre 1995	MD092	P	P	TTC	G-P	G-P	X	M
NF Big River	Pre 1995	MD094	X	SNC	SNC	SNC	SNC	SNC	SNC
W. Chamberlain Creek	Pre 1995	MD258	X	X	M	M	M	M	X
Berry Gulch	Pre 1995	MD164	N, 1F	P	N, 1F	P	N,1Y	X	U
Chamberlain Creek	Pre 1995	MD124	M	I	I	I	I	I	X
Dunlap	Pre 1995	MD142	X	X	X	X	SNC	X	SNC
James Creek	Pre 1995	MD309	P	N, 2Y	P, I	P, I	P, I	N, 2Y	N, 2Y
Lower James Creek	Pre 1995	MD259	P	N, 1F	N, 1Y	N, 1Y	N, 1F	P, I	P
NF James Creek	Pre 1995	MD093	N, 2F	N, 1F	P	P	P, 0Y	N, 0Y	N, 2Y
Park Gulch	Pre 1995	MD002	X	X	X	X	SNC	X	SNC
Casper Creek	Pre 1995	MD091	P	P	N, 1Y	P	P	P	P
Hare Creek	Pre 1995	MD165	*X	SNC	SNC	SNC	SNC	X	SNC
Active Territories			13	9	9	9	8	8	7
Total Pairs			11	9	8	8	7	6	5
Nesting Pairs			6	6	5	2	4	4	2
Total Known Young Fledged			7	5	2	0	1	0	0

Key: M=Single Male, **F**=Single Female, **U**=Single Unknown sex, **P**=Pair (non nesting), **N**=Pair (nesting), **Y**=Young, **F** = Fledged Young, **SNC**=Site not checked, **X**=No owls detected, **I**= Inconclusive, **TTC**=Pair moved to TTC ownership, **G-P**= Pair moved to the former G-P ownership. **D**=Site Dropped, *Hare Creek Site (MD165) often used by the pair from MD091.

APPENDIX 8F: WILDLIFE
LIST OF CWHR MAMMALS, BIRDS, REPTILES AND AMPHIBIANS AND ASSOCIATED HABITATS TYPE THAT ARE EITHER KNOWN OR HAVE THE POTENTIAL TO OCCUR ON OR IN THE VICINITY OF JDSF (CDFG 1999b)

ACORN WOODPECKER	MONTANE HARDWOOD-CONIFER
ALLEN'S CHIPMUNK	MONTANE HARDWOOD-CONIFER
ALLEN'S HUMMINGBIRD	MONTANE HARDWOOD-CONIFER
AMERICAN BADGER	MONTANE HARDWOOD-CONIFER
AMERICAN BEAVER	MONTANE HARDWOOD-CONIFER
AMERICAN COOT	ANNUAL GRASS
AMERICAN CROW	MONTANE HARDWOOD-CONIFER
AMERICAN DIPPER	MONTANE RIPARIAN
AMERICAN GOLDFINCH	MONTANE HARDWOOD-CONIFER
AMERICAN KESTREL	MONTANE HARDWOOD-CONIFER
AMERICAN MARTEN	MONTANE HARDWOOD-CONIFER
AMERICAN MINK	MONTANE RIPARIAN
AMERICAN PIPIT	ANNUAL GRASS
AMERICAN ROBIN	MONTANE HARDWOOD-CONIFER
AMERICAN WHITE PELICAN	RIVERINE
AMERICAN WIGEON	ANNUAL GRASS
ANNA'S HUMMINGBIRD	MONTANE HARDWOOD-CONIFER
ARBOREAL SALAMANDER	DOUGLAS-FIR
ASH-THROATED FLYCATCHER	MONTANE HARDWOOD-CONIFER
BAIRD'S SANDPIPER	RIVERINE
BALD EAGLE	MONTANE HARDWOOD-CONIFER
BAND-TAILED PIGEON	MONTANE HARDWOOD-CONIFER
BANK SWALLOW	MONTANE RIPARIAN
BARN OWL	MONTANE HARDWOOD-CONIFER
BARN SWALLOW	MONTANE HARDWOOD-CONIFER
BARRED OWL	MONTANE HARDWOOD-CONIFER
BARROW'S GOLDENEYE	RIVERINE
BELTED KINGFISHER	REDWOOD
BEWICK'S WREN	MONTANE HARDWOOD-CONIFER
BIG BROWN BAT	MONTANE HARDWOOD-CONIFER
BLACK BEAR	MONTANE HARDWOOD-CONIFER
BLACK PHOEBE	MONTANE HARDWOOD-CONIFER
BLACK RAT	DOUGLAS-FIR
BLACK SALAMANDER	MONTANE HARDWOOD-CONIFER
BLACK-BELLIED PLOVER	ANNUAL GRASS
BLACK-CROWNED NIGHT HERON	MONTANE HARDWOOD-CONIFER

BLACK-HEADED GROSBEAK	MONTANE HARDWOOD-CONIFER
BLACK-TAILED JACKRABBIT	MONTANE HARDWOOD-CONIFER
BLACK-THROATED GRAY WARBLER	MONTANE HARDWOOD-CONIFER
BLUE GROUSE	MONTANE HARDWOOD-CONIFER
BLUE-GRAY GNATCATCHER	MIXED CHAPARRAL
BLUE-WINGED TEAL	ANNUAL GRASS
BOBCAT	MONTANE HARDWOOD-CONIFER
BONAPARTE'S GULL	RIVERINE
BOTTA'S POCKET GOPHER	MONTANE HARDWOOD-CONIFER
BRANDT'S CORMORANT	RIVERINE
BRANT	ANNUAL GRASS
BRAZILIAN FREE-TAILED BAT	MONTANE HARDWOOD-CONIFER
BREWER'S BLACKBIRD	MONTANE HARDWOOD-CONIFER
BROAD-FOOTED MOLE	MONTANE HARDWOOD-CONIFER
BROWN CREEPER	MONTANE HARDWOOD-CONIFER
BROWN PELICAN	ANNUAL GRASS
BROWN-HEADED COWBIRD	MONTANE HARDWOOD-CONIFER
BRUSH MOUSE	MONTANE HARDWOOD-CONIFER
BRUSH RABBIT	MONTANE HARDWOOD-CONIFER
BUFFLEHEAD	MONTANE RIPARIAN
BULLFROG	MONTANE HARDWOOD-CONIFER
BULLOCK'S ORIOLE	MONTANE HARDWOOD-CONIFER
BURROWING OWL	MIXED CHAPARRAL
BUSHTIT	MONTANE HARDWOOD-CONIFER
BUSHY-TAILED WOODRAT	MONTANE HARDWOOD-CONIFER
CALIFORNIA GIANT SALAMANDER	MONTANE HARDWOOD-CONIFER
CALIFORNIA GROUND SQUIRREL	MONTANE HARDWOOD-CONIFER
CALIFORNIA GULL	ANNUAL GRASS
CALIFORNIA KANGAROO RAT	MIXED CHAPARRAL
CALIFORNIA MOUNTAIN KINGSNAKE	MONTANE HARDWOOD-CONIFER
CALIFORNIA MYOTIS	MONTANE HARDWOOD-CONIFER
CALIFORNIA NEWT	MONTANE HARDWOOD-CONIFER
CALIFORNIA QUAIL	MONTANE HARDWOOD-CONIFER
CALIFORNIA SEA-LION	RIVERINE
CALIFORNIA SLENDER SALAMANDER	DOUGLAS-FIR
CALIFORNIA THRASHER	MONTANE HARDWOOD-CONIFER
CALIFORNIA TOWHEE	MONTANE HARDWOOD-CONIFER
CALIFORNIA VOLE	MONTANE HARDWOOD-CONIFER
CALLIOPE HUMMINGBIRD	MONTANE HARDWOOD-CONIFER
CANADA GOOSE	ANNUAL GRASS
CANVASBACK	RIVERINE

CANYON WREN	MONTANE RIPARIAN
CASPIAN TERN	RIVERINE
CASSIN'S FINCH	DOUGLAS-FIR
CASSIN'S VIREO	MONTANE HARDWOOD-CONIFER
CATTLE EGRET	ANNUAL GRASS
CEDAR WAXWING	MONTANE HARDWOOD-CONIFER
CHESTNUT-BACKED CHICKADEE	MONTANE HARDWOOD-CONIFER
CHIMNEY SWIFT	MONTANE HARDWOOD-CONIFER
CHIPPING SPARROW	MONTANE HARDWOOD-CONIFER
CINNAMON TEAL	ANNUAL GRASS
CLARK'S GREBE	RIVERINE
CLARK'S NUTCRACKER	DOUGLAS-FIR
CLIFF SWALLOW	REDWOOD
CLOUDED SALAMANDER	MONTANE HARDWOOD-CONIFER
COAST MOLE	MONTANE HARDWOOD-CONIFER
COMMON GARTER SNAKE	MONTANE HARDWOOD-CONIFER
COMMON GOLDENEYE	RIVERINE
COMMON KINGSNAKE	MONTANE HARDWOOD-CONIFER
COMMON MERGANSER	MONTANE RIPARIAN
COMMON MOORHEN	RIVERINE
COMMON MUSKRAT	MONTANE RIPARIAN
COMMON NIGHTHAWK	MONTANE HARDWOOD-CONIFER
COMMON POORWILL	MONTANE HARDWOOD-CONIFER
COMMON PORCUPINE	MONTANE HARDWOOD-CONIFER
COMMON RAVEN	MONTANE HARDWOOD-CONIFER
COMMON SNIPE	RIVERINE
COMMON TERN	RIVERINE
COMMON YELLOWTHROAT	MONTANE RIPARIAN
COOPER'S HAWK	MONTANE HARDWOOD-CONIFER
COYOTE	MONTANE HARDWOOD-CONIFER
CREEPING VOLE	MONTANE HARDWOOD-CONIFER
DARK-EYED JUNCO	MONTANE HARDWOOD-CONIFER
DEER MOUSE	MONTANE HARDWOOD-CONIFER
DOUBLE-CRESTED CORMORANT	RIVERINE
DOUGLAS' SQUIRREL	MONTANE HARDWOOD-CONIFER
DOWNY WOODPECKER	MONTANE HARDWOOD-CONIFER
DUNLIN	RIVERINE
DUSKY FLYCATCHER	MONTANE HARDWOOD-CONIFER
DUSKY-FOOTED WOODRAT	MONTANE HARDWOOD-CONIFER
EARED GREBE	RIVERINE
ELK	MONTANE HARDWOOD-CONIFER

ENSATINA	MONTANE HARDWOOD-CONIFER
ERMINE	MONTANE HARDWOOD-CONIFER
EUROPEAN STARLING	MONTANE HARDWOOD-CONIFER
EVENING GROSBEAK	MONTANE HARDWOOD-CONIFER
FALLOW DEER	MIXED CHAPARRAL
FERRUGINOUS HAWK	ANNUAL GRASS
FISHER	MONTANE HARDWOOD-CONIFER
FLAMMULATED OWL	MONTANE HARDWOOD-CONIFER
FOG SHREW	MONTANE HARDWOOD-CONIFER
FOOTHILL YELLOW-LEGGED FROG	MONTANE HARDWOOD-CONIFER
FORSTER'S TERN	RIVERINE
FOX SPARROW	MONTANE HARDWOOD-CONIFER
FRINGED MYOTIS	MONTANE HARDWOOD-CONIFER
GADWALL	ANNUAL GRASS
GOLDEN EAGLE	MONTANE HARDWOOD-CONIFER
GOLDEN-CROWNED KINGLET	MONTANE HARDWOOD-CONIFER
GOLDEN-CROWNED SPARROW	MONTANE HARDWOOD-CONIFER
GOLDEN-MANTLED GROUND SQUIRREL	MONTANE HARDWOOD-CONIFER
GOPHER SNAKE	MONTANE HARDWOOD-CONIFER
GRASSHOPPER SPARROW	ANNUAL GRASS
GRAY FOX	MONTANE HARDWOOD-CONIFER
GRAY JAY	DOUGLAS-FIR
GREAT BLUE HERON	MONTANE HARDWOOD-CONIFER
GREAT EGRET	MONTANE HARDWOOD-CONIFER
GREAT HORNED OWL	MONTANE HARDWOOD-CONIFER
GREATER ROADRUNNER	MIXED CHAPARRAL
GREATER WHITE-FRONTED GOOSE	ANNUAL GRASS
GREATER YELLOWLEGS	RIVERINE
GREEN HERON	MONTANE HARDWOOD-CONIFER
GREEN-TAILED TOWHEE	MONTANE HARDWOOD-CONIFER
GREEN-WINGED TEAL	MONTANE RIPARIAN
HAIRY WOODPECKER	MONTANE HARDWOOD-CONIFER
HAMMOND'S FLYCATCHER	MONTANE HARDWOOD-CONIFER
HARBOR SEAL	RIVERINE
HARLEQUIN DUCK	RIVERINE
HARRIS'S SPARROW	MONTANE HARDWOOD-CONIFER
HERMIT THRUSH	MONTANE HARDWOOD-CONIFER
HERMIT WARBLER	MONTANE HARDWOOD-CONIFER
HERRING GULL	RIVERINE
HOARY BAT	MONTANE HARDWOOD-CONIFER
HOODED MERGANSER	RIVERINE

HORNED LARK	ANNUAL GRASS
HOUSE FINCH	MONTANE HARDWOOD-CONIFER
HOUSE MOUSE	MONTANE HARDWOOD-CONIFER
HOUSE WREN	MONTANE HARDWOOD-CONIFER
HUTTON'S VIREO	MONTANE HARDWOOD-CONIFER
INDIGO BUNTING	MONTANE HARDWOOD-CONIFER
KILLDEER	ANNUAL GRASS
LARK SPARROW	MONTANE HARDWOOD-CONIFER
LAWRENCE'S GOLDFINCH	MONTANE HARDWOOD-CONIFER
LAZULI BUNTING	MONTANE HARDWOOD-CONIFER
LEAST SANDPIPER	RIVERINE
LESSER GOLDFINCH	MONTANE HARDWOOD-CONIFER
LESSER SCAUP	ANNUAL GRASS
LESSER YELLOWLEGS	RIVERINE
LEWIS' WOODPECKER	MONTANE HARDWOOD-CONIFER
LINCOLN'S SPARROW	MONTANE HARDWOOD-CONIFER
LITTLE BROWN MYOTIS	MONTANE HARDWOOD-CONIFER
LOGGERHEAD SHRIKE	MONTANE HARDWOOD-CONIFER
LONG-BILLED CURLEW	ANNUAL GRASS
LONG-BILLED DOWITCHER	RIVERINE
LONG-EARED MYOTIS	MONTANE HARDWOOD-CONIFER
LONG-LEGGED MYOTIS	MONTANE HARDWOOD-CONIFER
LONG-NOSED SNAKE	MIXED CHAPARRAL
LONG-TAILED VOLE	MONTANE HARDWOOD-CONIFER
LONG-TAILED WEASEL	MONTANE HARDWOOD-CONIFER
MACGILLIVRAY'S WARBLER	MONTANE HARDWOOD-CONIFER
MALLARD	MONTANE RIPARIAN
MARBLED GODWIT	ANNUAL GRASS
MARBLED MURRELET	DOUGLAS-FIR
MARSH SHREW	MONTANE HARDWOOD-CONIFER
MARSH WREN	MONTANE RIPARIAN
MERLIN	MONTANE HARDWOOD-CONIFER
MEW GULL	RIVERINE
MOUNTAIN BEAVER	MONTANE HARDWOOD-CONIFER
MOUNTAIN BLUEBIRD	MONTANE RIPARIAN
MOUNTAIN CHICKADEE	MONTANE HARDWOOD-CONIFER
MOUNTAIN LION	MONTANE HARDWOOD-CONIFER
MOUNTAIN QUAIL	MONTANE HARDWOOD-CONIFER
MOURNING DOVE	MONTANE HARDWOOD-CONIFER
MULE DEER	MONTANE HARDWOOD-CONIFER
NASHVILLE WARBLER	MONTANE HARDWOOD-CONIFER

NORTHERN ALLIGATOR LIZARD	MONTANE HARDWOOD-CONIFER
NORTHERN FLICKER	MONTANE HARDWOOD-CONIFER
NORTHERN FLYING SQUIRREL	MONTANE HARDWOOD-CONIFER
NORTHERN GOSHAWK	MONTANE HARDWOOD-CONIFER
NORTHERN HARRIER	MONTANE HARDWOOD-CONIFER
NORTHERN MOCKINGBIRD	MIXED CHAPARRAL
NORTHERN PINTAIL	ANNUAL GRASS
NORTHERN PYGMY OWL	MONTANE HARDWOOD-CONIFER
NORTHERN RIVER OTTER	MONTANE RIPARIAN
NORTHERN ROUGH-WINGED SWALLOW	MONTANE HARDWOOD-CONIFER
NORTHERN SAW-WHET OWL	MONTANE HARDWOOD-CONIFER
NORTHERN SHOVELER	ANNUAL GRASS
NORTHWESTERN SALAMANDER	MONTANE HARDWOOD-CONIFER
NORWAY RAT	DOUGLAS-FIR
NUTTALL'S WOODPECKER	MONTANE HARDWOOD-CONIFER
OAK TITMOUSE	MONTANE HARDWOOD-CONIFER
OLIVE-SIDED FLYCATCHER	MONTANE HARDWOOD-CONIFER
ORANGE-CROWNED WARBLER	MONTANE HARDWOOD-CONIFER
ORNATE SHREW	MONTANE HARDWOOD-CONIFER
OSPREY	MONTANE HARDWOOD-CONIFER
PACIFIC CHORUS FROG	MONTANE HARDWOOD-CONIFER
PACIFIC COAST AQUATIC GARTER SNAKE	MONTANE HARDWOOD-CONIFER
PACIFIC GIANT SALAMANDER	MONTANE HARDWOOD-CONIFER
PACIFIC GOLDEN-PLOVER	ANNUAL GRASS
PACIFIC JUMPING MOUSE	MONTANE HARDWOOD-CONIFER
PACIFIC-SLOPE FLYCATCHER	MONTANE HARDWOOD-CONIFER
PALLID BAT	MONTANE HARDWOOD-CONIFER
PELAGIC CORMORANT	RIVERINE
PEREGRINE FALCON	MONTANE HARDWOOD-CONIFER
PIED-BILLED GREBE	RIVERINE
PILEATED WOODPECKER	MONTANE HARDWOOD-CONIFER
PINE SISKIN	MONTANE HARDWOOD-CONIFER
PINON MOUSE	MONTANE HARDWOOD-CONIFER
PLUMBEOUS VIREO	MONTANE HARDWOOD-CONIFER
PRAIRIE FALCON	MONTANE HARDWOOD-CONIFER
PURPLE FINCH	MONTANE HARDWOOD-CONIFER
PURPLE MARTIN	MONTANE HARDWOOD-CONIFER
PYGMY NUTHATCH	MONTANE HARDWOOD-CONIFER
RACCOON	MONTANE HARDWOOD-CONIFER
RACER	MONTANE HARDWOOD-CONIFER
RED CROSSBILL	MONTANE HARDWOOD-CONIFER

RED FOX	MONTANE HARDWOOD-CONIFER
RED-BELLIED NEWT	MONTANE HARDWOOD-CONIFER
RED-BREASTED NUTHATCH	MONTANE HARDWOOD-CONIFER
RED-BREASTED SAPSUCKER	MONTANE HARDWOOD-CONIFER
RED-LEGGED FROG	MONTANE HARDWOOD-CONIFER
RED-SHOULDERED HAWK	MONTANE HARDWOOD-CONIFER
RED-TAILED HAWK	MONTANE HARDWOOD-CONIFER
RED-WINGED BLACKBIRD	MONTANE RIPARIAN
REDHEAD	RIVERINE
RING-BILLED GULL	ANNUAL GRASS
RING-NECKED PHEASANT	MIXED CHAPARRAL
RINGNECK SNAKE	MONTANE HARDWOOD-CONIFER
RINGTAIL	MONTANE HARDWOOD-CONIFER
ROCK DOVE	ANNUAL GRASS
ROCK WREN	MONTANE HARDWOOD-CONIFER
ROUGH-LEGGED HAWK	ANNUAL GRASS
ROUGH-SKINNED NEWT	MONTANE HARDWOOD-CONIFER
RUBBER BOA	MONTANE HARDWOOD-CONIFER
RUBY-CROWNED KINGLET	MONTANE HARDWOOD-CONIFER
RUFFED GROUSE	MONTANE HARDWOOD-CONIFER
RUFOUS HUMMINGBIRD	MONTANE HARDWOOD-CONIFER
RUFOUS-CROWNED SPARROW	MIXED CHAPARRAL
SAGE SPARROW	MIXED CHAPARRAL
SAGEBRUSH LIZARD	MONTANE HARDWOOD-CONIFER
SANDERLING	RIVERINE
SAVANNAH SPARROW	MIXED CHAPARRAL
SAY'S PHOEBE	MIXED CHAPARRAL
SEMIPALMATED PLOVER	ANNUAL GRASS
SHARP-SHINNED HAWK	MONTANE HARDWOOD-CONIFER
SHARP-TAILED SNAKE	MONTANE HARDWOOD-CONIFER
SHORT-BILLED DOWITCHER	RIVERINE
SHORT-EARED OWL	MONTANE HARDWOOD-CONIFER
SHREW-MOLE	MONTANE HARDWOOD-CONIFER
SILVER-HAIRED BAT	MONTANE HARDWOOD-CONIFER
SNOW GOOSE	ANNUAL GRASS
SNOWSHOE HARE	DOUGLAS-FIR
SNOWY EGRET	MONTANE RIPARIAN
SONG SPARROW	MONTANE HARDWOOD-CONIFER
SONOMA CHIPMUNK	MONTANE HARDWOOD-CONIFER
SOUTHERN ALLIGATOR LIZARD	MONTANE HARDWOOD-CONIFER
SOUTHERN SEEP SALAMANDER	MONTANE HARDWOOD-CONIFER

SPOTTED OWL	MONTANE HARDWOOD-CONIFER
SPOTTED SANDPIPER	ANNUAL GRASS
SPOTTED TOWHEE	MONTANE HARDWOOD-CONIFER
STELLER'S JAY	MONTANE HARDWOOD-CONIFER
STRIPED RACER	MONTANE HARDWOOD-CONIFER
STRIPED SKUNK	MONTANE HARDWOOD-CONIFER
SURF SCOTER	RIVERINE
SWAINSON'S THRUSH	MONTANE HARDWOOD-CONIFER
TAILED FROG	MONTANE HARDWOOD-CONIFER
TOWNSEND'S BIG-EARED BAT	MONTANE HARDWOOD-CONIFER
TOWNSEND'S SOLITAIRE	MONTANE RIPARIAN
TOWNSEND'S WARBLER	MONTANE HARDWOOD-CONIFER
TREE SWALLOW	MONTANE HARDWOOD-CONIFER
TRICOLORED BLACKBIRD	ANNUAL GRASS
TROWBRIDGE'S SHREW	MONTANE HARDWOOD-CONIFER
TUNDRA SWAN	ANNUAL GRASS
TURKEY VULTURE	MONTANE HARDWOOD-CONIFER
VAGRANT SHREW	MONTANE HARDWOOD-CONIFER
VARIED THRUSH	MONTANE HARDWOOD-CONIFER
VAUX'S SWIFT	MONTANE HARDWOOD-CONIFER
VIOLET-GREEN SWALLOW	MONTANE HARDWOOD-CONIFER
VIRGINIA OPOSSUM	MONTANE HARDWOOD-CONIFER
VIRGINIA RAIL	MONTANE RIPARIAN
WARBLING VIREO	MONTANE HARDWOOD-CONIFER
WATER SHREW	MONTANE HARDWOOD-CONIFER
WESTERN BLUEBIRD	MONTANE HARDWOOD-CONIFER
WESTERN FENCE LIZARD	MONTANE HARDWOOD-CONIFER
WESTERN GRAY SQUIRREL	MONTANE HARDWOOD-CONIFER
WESTERN GREBE	RIVERINE
WESTERN HARVEST MOUSE	MONTANE HARDWOOD-CONIFER
WESTERN JUMPING MOUSE	MONTANE RIPARIAN
WESTERN KINGBIRD	MONTANE HARDWOOD-CONIFER
WESTERN MEADOWLARK	MONTANE HARDWOOD-CONIFER
WESTERN PIPISTRELLE	MONTANE HARDWOOD-CONIFER
WESTERN POND TURTLE	MONTANE HARDWOOD-CONIFER
WESTERN RATTLESNAKE	MONTANE HARDWOOD-CONIFER
WESTERN RED BAT	MONTANE HARDWOOD-CONIFER
WESTERN RED-BACKED VOLE	MONTANE HARDWOOD-CONIFER
WESTERN SANDPIPER	RIVERINE
WESTERN SCREECH OWL	MONTANE HARDWOOD-CONIFER
WESTERN SCRUB-JAY	MONTANE HARDWOOD-CONIFER

WESTERN SKINK	MONTANE HARDWOOD-CONIFER
WESTERN SPOTTED SKUNK	MONTANE HARDWOOD-CONIFER
WESTERN TANAGER	MONTANE HARDWOOD-CONIFER
WESTERN TERRESTRIAL GARTER SNAKE	MONTANE HARDWOOD-CONIFER
WESTERN TOAD	MONTANE HARDWOOD-CONIFER
WESTERN WHIPTAIL	MONTANE HARDWOOD-CONIFER
WESTERN WOOD-PEWEE	MONTANE HARDWOOD-CONIFER
WHIMBREL	ANNUAL GRASS
WHITE-BREASTED NUTHATCH	MONTANE HARDWOOD-CONIFER
WHITE-CROWNED SPARROW	MONTANE HARDWOOD-CONIFER
WHITE-HEADED WOODPECKER	MONTANE HARDWOOD-CONIFER
WHITE-TAILED KITE	REDWOOD
WHITE-THROATED SPARROW	MONTANE HARDWOOD-CONIFER
WHITE-THROATED SWIFT	MONTANE HARDWOOD-CONIFER
WILD PIG	MONTANE HARDWOOD-CONIFER
WILD TURKEY	MONTANE HARDWOOD-CONIFER
WILLET	ANNUAL GRASS
WILLOW FLYCATCHER	MONTANE RIPARIAN
WILSON'S WARBLER	MONTANE HARDWOOD-CONIFER
WINTER WREN	MONTANE HARDWOOD-CONIFER
WOOD DUCK	MONTANE HARDWOOD-CONIFER
WRENTIT	MONTANE HARDWOOD-CONIFER
YELLOW WARBLER	MONTANE HARDWOOD-CONIFER
YELLOW-BREASTED CHAT	MONTANE RIPARIAN
YELLOW-CHEEKED CHIPMUNK	MONTANE HARDWOOD-CONIFER
YELLOW-PINE CHIPMUNK	MONTANE HARDWOOD-CONIFER
YELLOW-RUMPED WARBLER	MONTANE HARDWOOD-CONIFER
YUMA MYOTIS	MONTANE HARDWOOD-CONIFER

APPENDIX 9
PERTINENT GEOLOGY-RELATED FOREST PRACTICE RULES

Pertinent regulations within the Forest Practice Rules are described below (they are not generally presented verbatim):

- **Article 4.** Harvesting Practices and Erosion Control

  Section 914: "Timber Operations shall be conducted to…prevent degradation of the quality and beneficial uses of water… and maintain site productivity by minimizing soil loss."

  Tractor Operations:
  914.2 (c): Tractor roads shall be limited in number and width to the minimum necessary for removal of logs.
  914.2 (d): Heavy equipment will not operate on unstable areas. If such areas are unavoidable, the RPF shall develop specific measures to minimize the effect of operations on slope stability. These measures shall be explained and justified in the plan.
  914.2 (f): Identifies limitations on tractor operations in the Coast District based on slope steepness and Erosion Hazard Rating.
  914.2 (i): Ensures installation of additional adequate erosion controls where standard water breaks are insufficient.

  Waterbreaks
  914.6 (a): Requires waterbreaks during the winter periods.
  914.6 (c): Defines appropriate waterbreak spacing based on Erosion Hazard Rating.
  914.6 (d): Waterbreaks required on incised cable roads.
  914.6 (e): Waterbreaks required at watercourse crossings on tractor roads and firebreaks unless permanent drainage facilities are present.
  914.6 (f): Requires energy dissipation at waterbreak outlets to mitigate potential erosion.
  914.6 (g): Defines waterbreak geometry.
  914.6 (h): Prescribes waterbreak maintenance.

  Winter Operations
  914.7: Describes need for a winter period operating plan, and defines elements of such a plan.
  914.7 (c): Prohibits tractor yarding on saturated soils. Requires erosion control on all skid trails and tractor roads prior to the end of the day if rainfall is predicted, or on weekends.

- Article 5. Site Preparation

  Section 915: "Site preparation operations shall be planned and conducted in a manner which… prevents substantial adverse effects to soil resources and to fish and wildlife habitat, and prevents degradation of the quality and beneficial uses of water."

  Use of Heavy Equipment
  915.1 (a): Use of heavy equipment for mechanical site preparation is subject to the same limitations as under 914.2.
  915.1 (b): Precludes heavy equipment operations on saturated soils.
  915.1 (c): Watercourse crossings shall be consistent with 914.8.
  915.1 (d): Energy dissipaters required to control and disperse concentrated runoff.

- Article 6. Watercourse and Lake Protection

  Section 916: "The purpose of this article is to ensure that the beneficial uses of water, native aquatic and riparian species, and the beneficial functions of riparian zones are protected from potentially significant adverse site-specific and cumulative impacts associated with timber operations."

  General Limitations Near Watercourses, Lakes, Marshes, Meadows, and Other Wet Areas
  916.3 (a): When reasonable expectation exists that slash, debris, soil, or other material from timber operations will be deposited in Class I or II watercourses, the activities shall be deferred until equipment is available for removal, or another procedure or schedule is approved.
  916.3 (b): Accidental deposition of soil or other debris in lakes or below the watercourse or lake transition line shall be removed immediately.
  916.3 (c): Roads or landings shall not be constructed in watercourses, in the WLPZ, marshes, wet meadows, and other wet areas unless explained and justified.
  916.3 (d): Vegetation and soil within meadows shall be protected to the maximum extent possible.
  916.3 (e): Trees cut within the WLPZ shall be felled away from the watercourse to protect the residual vegetation in the WLPZ.
  916.3 (f): Requires minimum canopy retention in the WLPZ.

  Reduction of Soil Loss
  916.7: "Within the watercourse and lake protection zone adjacent to Class I and Class II waters, areas where mineral soil exceeding 800 continuous square feet in size, exposed by timber operations, shall be treated for reduction of soil loss. Treatment shall be completed by October 15… Stabilization measures shall be selected that will prevent significant movement of soil into Class I and II waters and may include, but need not be limited to, mulching, rip-rapping, grass seeding, or chemical soil stabilizers."

Protection and Restoration in Watersheds with Threatened or Impaired Values

916.9 (a): "Every timber operation shall be planned and conducted to prevent deleterious interference with the watershed conditions that primarily limit the values set forth in 14 CCR 916.2 (a) (e.g. sediment load increase where sediment is a primary limiting factor…). To achieve this goal, every timber operation shall be planned and conducted to meet the following objectives where they affect a primary limiting factor:

(1) Comply with the terms of a Total Maximum Daily Load (TMDL) that has been adopted to address factors that may be affected by timber operations if a TMDL has been adopted, or not result in any measurable sediment load increase to a watercourse system or lake.
(2) Not result in any measurable decrease in the stability of a watercourse channel or of a watercourse or lake bank.

916.9 (f): Defines minimum WLPZ width for Class I waters as 150 feet.

916.9 (g): Defines minimum canopy retention values for Class I WLPZ of 85% within 75 feet of watercourse or lake, and 65% within remainder.

916.9 (j): "Where an inner gorge extends beyond a Class I WLPZ and slopes are greater than 55%, a special management zone shall be established where the use of even-aged regeneration methods is prohibited. This zone shall extend upslope to the first major break-in-slope to less than 55% for a distance of 100 feet or more, or 300 feet as measured from the watercourse or lake transition line, which ever is less. All operations on slopes exceeding 65% within an inner gorge of a Class I or II Watercourse shall be reviewed by a Registered Geologist prior to plan approval, regardless of whether they are proposed within a WLPZ or outside of a WLPZ."

916.9 (k): Restricts tractor operations during the wet season on slopes steeper than 40% near Class I, II, or III watercourses; and confines truck and heavy equipment operation to roads and landings with a "stable operating surface."

916.9 (l): Requires Winter operating plan for construction or reconstruction of logging roads, tractor roads, and landings. Use of logging roads, tractor roads, and landings are prohibited where saturated soil conditions exist, where a stable logging road or landing does not exist, or when visibly turbid water from the road, landing, or skid trail surface or inside ditch may reach a watercourse or lake.

916.9 (m): Requires drainage improvements be in place prior to the start of any rain or any day with a 30% or more chance of rain.

916.9 (n): Provides standards for treatments to stabilize soils, minimize soil erosion, and prevent the discharge of sediment into waters in amounts deleterious to aquatic species or the quality and beneficial uses of water. These standards apply to the traveled surface of logging roads, disturbed areas, and undisturbed areas whose natural ground cover cannot effectively protect beneficial uses of water from logging activities.

916.9 (o): Requires the RPF to identify active erosion sites in the logging area, and to determine whether feasible remedies exist.

916.9 (p): Defines the erosion control maintenance period on permanent and seasonal roads that are not abandoned as three years.

916.9 (q): Requires site preparation activities be designed to prevent soil disturbance within, and minimize soil movement into, the channels of watercourses.

- Article 11. Coastal Commission Special Treatment Areas

Section 921: "The purpose of this article is to protect the natural and scenic qualities as reflected in the criteria and objectives for each of the Coastal Commission Special Treatment Areas designated and adopted by the California Coastal Commission on July 5, 1977, while at the same time allowing management and orderly harvesting of timber resources within these areas."

Logging Practices (Coast, Special Treatment Area)

921.5 (a): Tractor logging prohibited on slopes steeper than 50% where HER is high or extreme and on slopes steeper than 60% where HER is low or moderate, unless shown to be associated with less disturbance potential than other methods.

921.5(b): Provides special requirements for roads to supplement guidelines in 14 CCR 923.2. Includes stipulation that roads not be constructed through slide areas unless the alignment is the best available altemative and special design features are incorporated.

921.5 (c): Soil disturbance, other than necessary for road maintenance, shall not occur under "excessively wet" conditions that could result in substantial soil compaction and erosion.

- Article 12. Logging Roads and Landings

Section 923: "all logging roads and landings in the logging area shall be planned, located, constructed, reconstructed, used, and maintained in a manner which…minimizes damage to soil resources and fish and wildlife habitat; and prevents degradation of the quality and beneficial uses of water. Consideration of feasible alternatives shall include:

(a) Use of existing roads whenever feasible.
(b) Use of systematic road layout to minimize total mileage.
(c) Planned to fit topography to minimize disturbance to the natural features of the site.
(d) Avoidance of routes near the bottoms of steep and narrow canyons, through marshes and wet meadows, on unstable areas, and near watercourses…
(e) Minimization of watercourse crossings.
(f) Location of roads on natural benches, flatter slopes, and areas of stable soils to minimize effects on watercourses.
(g) Use of logging systems that will reduce excavation or placement of fills on unstable areas.

Planning for Roads and Landings

923.1 (c): Logging roads and landings shall be planned and located, when feasible, to avoid unstable areas.

923.1 (d): Requires measures to minimize movement of soil and the discharge of concentrated surface runoff where roads and landings will be located across 100 feet or more of slopes over 65%, or on slopes over 50% within 100 feet of a WLPZ. End-hauling of sediment may be required from areas within 100 feet of the boundary of a WLPZ.

923.1 (e): Limits steepness of road grades to minimize soil disturbance.

923.1 (f): Roads and landings must be planned so that an adequate number of drainage facilities are installed to minimize erosion on roadbeds, landing surfaces, sidecast and fills.

923.1 (h): Road construction shall be planned to avoid WLPZs unless explained and justified.

Road Construction

923.2 (b): Prohibits fill placement and sidecasting on roads with greater than 100 feet on slopes in excess of 65%.

923.2 (c): On slopes greater than 50%, where the length of road section is greater than 100 feet, and the road is more than 15 feet wide, and the fill is more than 4 feet in vertical height at the road shoulder for the entire 100 feet, the road shall be constructed on a bench that is excavated at the proposed toe of the compacted fill and the fill shall be compacted.

923.2 (d): Fills shall be constructed in a manner to minimize erosion of fill slopes using techniques such as insloping through-fill approaches, waterbars, berms, rock armoring of fill slopes, or other suitable methods.

923.2 (e): Through fills shall be constructed in approximately one foot lifts.

923.2 (f): On slopes greater than 35%, the organic layer of the soil shall be substantially disturbed or removed prior to fill placement.

923.2 (g): Excess material from road construction and reconstruction shall be deposited and stabilized in a manner or in areas where downstream beneficial uses of water will not be adversely affected.

923.2 (h): Requires drainage structures to be of sufficient size, number and location to minimize erosion, to ensure proper functioning, and to maintain or restore the natural drainage pattern. Permanent watercourse crossings and associated fills are to be constructed to preclude diversion of flow down the road and to minimize fill erosion should the drainage structure become plugged.

923.2 (i): Requires oversize culvert, trash racks, or similar devices where it is likely that soil or other debris may significantly reduce the culvert capacity.

923.2 (j): Organic debris shall not be incorporated into fills.

923.2 (k): Precludes overhanging cut banks.

923.2 (l): Trees larger than 12 inches with more than 25% of the root surface exposed by road construction, shall be removed.

923.2 (m): Sidecast or fill material extending more than 20 feet in slope distance from the outside edge of the roadbed which has access to a watercourse or lake which is protected by a WLPZ shall be seeded, planted, mulched, removed, or treated to adequately reduce soil erosion.

923.2 (n): If water is present at the time of construction or reconstruction, a watercourse crossing shall be completed with necessary protective measures. Otherwise, protective measures need to be in place prior to October 15.

923.2 (o): Energy dissipaters are required where drainage structures discharge onto erodible materials.

923.2 (q): Drainage facilities need to be in place and functional prior to October 15.

923.2 (r): No road construction under saturated soil conditions.

923.2 (s): Completed road construction shall be drained by outsloping, waterbreaks, and/or cross-draining before October 15.

923.2 (t): Roads to be used for log hauling during the winter period shall be, where necessary, surfaced with rock in depth and quantity sufficient to maintain a stable road surface.

923.2 (v): Road construction activities in the WLPZ, except for stream crossings, shall be prohibited.

Watercourse Crossings

923.3 (b): The number of crossings shall be kept to a feasible minimum.

923.3 (d): Removal of watercourse crossings will provide a stable, natural channel configuration that is sufficiently sloped back to minimize slumping and soil erosion. If necessary, the material shall be stabilized by seeding, mulching, rock armoring, or other suitable treatment.

923.3 (e): All permanent watercourse crossings shall accommodate a 100 year flood, including debris and sediment loads.

923.3 (f): Permanent watercourse crossings shall be constructed to preclude stream diversion onto the road surface and to minimize fill erosion should the drainage structure become obstructed.

Road Maintenance

923.4: "Logging roads, landings, and associated drainage structures used in a timber operation shall be maintained in a manner which minimizes concentration of runoff, soil erosion, and slope instability and which prevents the degradation of the quality and beneficial uses of water during timber operations and throughout the prescribed maintenance period."

923.4 (a): The prescribed maintenance period for erosion controls on permanent and seasonal roads is one year, unless otherwise prescribed, to a maximum of three years.

923.4 (b): Rules for abandonment of roads and landings per 14 CCR 923.8.

923.4 (c): Waterbreaks shall be maintained per 14 CCR 914.6.

923.4 (e): Before the beginning of the winter period, all roadside berms shall be removed, unless necessary for erosion control.

923.4 (g): Temporary roads shall be blocked or otherwise closed to normal vehicular traffic before the winter period.

923.4 (h): During timber operations, road running surfaces in the logging area shall be treated as necessary to prevent excessive loss of road surface materials by, but not limited to, rocking, watering, chemically treating, asphalting, or oiling.

923.4 (i): Soil stabilization treatments on road or landing cuts, fills, or sidecast, shall be installed or renewed, when such treatment could minimize surface erosion which threatens the beneficial uses of water.

923.4 (j): Drainage ditches shall be maintained to allow free flow of water and minimize soil erosion.

923.4 (k): Action will be taken to prevent failures of cut, fill, or sidecast slopes from discharging materials into watercourses or lakes in quantities deleterious to the quality or beneficial uses of water.

923.4 (l): Drainage structures and trash racks shall be maintained and repaired to prevent blockage and to provide adequate carrying capacity. Where not present, new trash racks shall be installed if necessary.

923.4 (m): Inlet and outlet structures, additional drainage structures, and other features to provide adequate capacity and to minimize erosion of road and landing fill and sidecast, and to minimize slope instability shall be repaired, replaced, or installed wherever such maintenance is needed to protect the quality and beneficial uses of water.

923.4 (n): Permanent watercourse crossings shall be maintained to prevent diversion of stream flow onto the road surface should the drainage structure become plugged.

923.4 (o): Except for emergencies and maintenance to protect water quality, use of heavy equipment for maintenance is prohibited during wet weather.

Landing Construction

923.5 (a): On slopes steeper than 65%, no fill shall be placed and sidecast shall be minimized to the degree feasible.

923.5 (b): On slopes greater than 50%, fills greater than 4 feet in vertical height at the outside shoulder of the landing shall be constructed on a bench and compacted in 1 foot lifts.

923.5 (c): No organic debris in fills.

923.5 (e): No landing construction under saturated conditions.

923.5 (f): Upon completion of operations or prior to October 15, unstable concentrations of soil or organic debris shall be removed or stabilized; ditches and culverts shall be cleaned; landings shall be appropriately drained, with suitably placed or protected discharge points; sidecast with delivery potential shall be treated to reduce erosion potential; organics shall be removed prior to fill placement.

Planned Abandonment of Roads, Watercourse Crossings, and Landings

923.8: "Abandonment of roads, watercourse crossings, and landings shall be planned and conducted in a manner which provides for permanent maintenance-free drainage, minimizes concentration of runoff, soil erosion and slope instability, prevents unnecessary damage to soil resources, promotes regeneration, and protects quality and beneficial uses of water." General guidelines for abandonment are provided.

APPENDIX 10
HERITAGE

10-A. RECORDED PREHISTORIC ARCHAEOLOGICAL AND NATIVE AMERICAN SITES IN JDSF					
IHR#[1]	**Trinomal (Primary #)**	**Description**	**Condition, Impacts Noted[2]**	**Significance[3]**	**References[4]**
1	CA-MEN-790/H (P-23-000727)	Large prehistoric village, house pits, wide variety of prehistoric artifacts, small logging camp remains?	Heavily impacted by road construction and past logging, archaeological excavations conducted	Potentially eligible – 4	1, 2, 4, Layton 1990
	CA-MEN-1250 (P-23-001145)	Sparse lithic flake scatter, metate fragments	Heavily impacted by road construction and maintenance activities	Potentially eligible – 4	4
3	CA-MEN-1360 (P-23-001256)	Sparse lithic scatter, light scatter of historic debris	Heavily impacted by road construction and past logging	Potentially eligible – 4	1, 2, 3, 4
	CA-MEN-1361 (P-23-001361)	Sparse lithic scatter, historic trash dump	Heavily impacted by road construction, past logging and a tree plantation	Potentially eligible – 4	1, 4
4	CA-MEN-1362 (P-23-001257)	Possible house pits, diverse prehistoric tool assemblage,	Heavily impacted by road construction, past logging and a modern campground (Indian Springs)	Potentially eligible – 4	1, 2, 3, 4
5	CA-MEN-1363 (P-23-001258)	lithic scatter, metate/mano fragments, light historic debris scatter, trestle remains	Heavily impacted by past logging	Potentially eligible – 4	1, 2, 3, 4
	CA-MEN-1364 (P-23-001259)	Sparse lithic scatter of flakes and formed tools	Disturbed by past logging	Potentially eligible – 4	1, 4
	CA-MEN-1365 (P-23-001260)	Extensive scatter of lithics and formed tools, hammerstones	Heavily impacted by past logging	Potentially eligible – 4	1, 4
	CA-MEN-1366 (P-23-001261)	Sparse lithic scatter, possible house pits,	Impacted by past logging	Potentially eligible – 4	1, 4
	CA-MEN-1367 (P-23-001263)	Sparse lithic scatter, groundstone fragments,	Heavily impacted by road construction and past logging, intensive archaeological surface collection	Potentially eligible – 4	1, 4
	CA-MEN-1369 (P-23-001264)	Sparse lithic scatter	Heavily impacted by road construction and past logging	Potentially eligible – 4	1, 4
	CA-MEN-1370 (P-23-001265)	Sparse lithic scatter, groundstone fragments	Heavily impacted by road construction and past logging	Potentially eligible – 4	1, 4

10-A. RECORDED PREHISTORIC ARCHAEOLOGICAL AND NATIVE AMERICAN SITES IN JDSF					
IHR#[1]	**Trinomal (Primary #)**	**Description**	**Condition, Impacts Noted[2]**	**Significance[3]**	**References[4]**
6	CA-MEN-1371 (P-23-001266)	Extensive scatter of lithics, formed flake tools and ground stone, possible midden, site of Caspar Lumber Company Camp 20	Heavily impacted by historic camp and modern recreation area	Potentially eligible – 4	1, 2, 3, 4
	CA-MEN-1372 (P-23-001267)	Sparse lithic scatter	heavily impacted by a variety of construction activities	Potentially eligible – 4	1, 4
	CA-MEN-1373 (P-23-001268)	Series of waterfalls and pools used by Native Americans for religious and purification purposes	Heavily impacted by logging operations on surrounding slopes	Potentially eligible – 1	1, 4, Clyde Stanley[5]
	CA-MEN-1693 (P-23-001578)	Sparse scatter of flakes, and tool and groundstone fragments	Heavily impacted by road construction	Potentially eligible – 4	4
	CA-MEN-1694 (P-23-001579)	Sparse lithic scatter, projectile point fragment, hammerstone	Impacted by road construction and past logging	Potentially eligible – 4	4
	CA-MEN-2893 (P-23-002507)	Sparse scatter of flakes and formed tool artifact fragments	Heavily impacted by road construction and forest management activities	Potentially eligible – 4	4
	CA-MEN-3017 (P-23-003388)	One house pit, sparse scatter of flakes and formed tool artifact	Heavily impacted by road construction and past logging	Potentially eligible – 4	4
	CA-MEN-3019 (P-23-002682)	Sparse scatter of lithics and groundstone artifacts	Heavily impacted by road construction and past logging	Potentially eligible – 4	4
				TOTAL	**20**

1) IHR: Inventory of Historic Resource number as assigned by Gary and Hines, 1993
2) Information about when impacts from past logging and road construction occurred is not documented. Some impacts have occurred prior to Forest ownership by CDF; some during CDF ownership
3) Significant/eligible for California Register of Historical Resources under criteria 1, 2, 3, 4 (see above)
4) References: 1 = Levulett and Bingham 1978
   2 = Gary and Hines 1993
   3 = Medin 1994
   4 = Betts 1999
5) Northern Pomo consultant

10-B. NOTED AND RECORDED HISTORIC PERIOD HERITAGE RESOURCES IN JDSF

IHR #[1]	Trinomial (Primary #)	Description	Condition, Impacts Noted[2]	Significance/ Criteria[3]	References[4]
1	CA-MEN-790/H (P-23-000727)	Three Chop Village - major archaeological site with prehistoric and historic components (small logging camp?)	Moderately good condition - heavily impacted from road construction and logging	Potentially eligible - 1, 4	1, 2, 3, 4
2	CA-MEN-1359H	JSF-1 Trestle	No remains present (vandalized, part collapsed, remainder removed in 1990)	Probably not significant	2, 3
3	CA-MEN-1360 (P-23-001256)	JSF-2 Apple Orchard- multicomponent, prehistoric lithic scatter, historic artifact scatter, 3 apple trees?	Heavily impacted by road construction and logging	Potentially eligible – 1, 4	
4	CA-MEN-1362 (P-23-001257)	JSF-4 Old Logging Camp? - prehistoric lithic site with possible historic component (site of blacksmith shop?)	Heavily impacted by modern 'Indian Springs Campsite', road construction, logging	Potentially eligible - 1, 4	1, 2, 3, 4
5	CA-MEN-1363 (P-23-001258)	JSF-5 Historic artifacts - multicomponent, prehistoric lithic scatter, historic scatter, trestle remains, privy pit	Heavily impacted by logging and road construction	Potentially eligible - 1, 4	1, 2, 3, 4
6	CA-MEN-1371 (P-23-001266)	JSF-Camp 20 - multicomponent, extensive prehistoric lithic scatter, possible midden, historic logging camp	Heavily impacted by Hwy 20 and by a variety of modern developments	Potentially eligible - 1, 4	1, 2, 3, 4
	CA-MEN-1796H	3-Chop Ridge Tie Camp - extensive scatter of remains of 1918-1920 camp	Best preserved camp remaining in JDSF	Potentially eligible - 1, 4	2, 3
8	CA-MEN-2125H	Cherry Flat - possible homestead, domestic artifacts	Impacted by removal of artifacts	Potentially eligible - 1, 4	2, 3
9	CA-MEN-2140H	Hare Creek Trestle - collapsed railroad trestle, railroad grades	Some vandalism, deterioration	Potentially eligible - 1, 3, 4	2, 3
10	CA-MEN-2296H	Misery Whip Camp, represents earliest period of JDSF logging	Impacted by archeological surface collection, and test excavations. Area logged	Potentially eligible - 1, 4	2, 3
11	CA-MEN-2297H	Cat Barn - for equipment repair, constructed in 1940, near Camp 20	Deteriorating - would require major repair and stabilization to preserve	National Register eligibility not determined – Not selected by CDF for preservation	2, 3

10-B. NOTED AND RECORDED HISTORIC PERIOD HERITAGE RESOURCES IN JDSF					
IHR #[1]	**Trinomial (Primary #)**	**Description**	**Condition, Impacts Noted[2]**	**Significance/ Criteria[3]**	**References[4]**
12	CA-MEN-2305H	Bear Gulch Culvert Camp - scatter of historic debris and stacked lumber	Somewhat impacted by road construction	Potentially eligible - 1, 4	2, 3
13	CA-MEN-ISO-11	Isolate - haul back block	Collected	Not significant	2, 3
14	CA-MEN-2336H	Camp 6 - low density scatter of historic debris	Unknown	Unknown	2, 3
15	CA-MEN-2371	JDSF Rock Cairn - not known if modern, historic or prehistoric	Unknown	Unknown	2, 3
16	CA-MEN-2384H	Bouten's Tramway - grade for tramway, log stringers, ties, iron bar, hand-dug trench	Impacted by collecting, fire and erosion	Potentially eligible - 1, 4	2, 3
17	CA-MEN-2413H	Camp 20 - numerous features representing remains of once extensive logging camp	Disturbed by 'clean-up', Hwy 20, development of modern recreation area	Potentially eligible - 1, 4; Represents most extensive of camps along Caspar and Hare Creek Railroad	2, 3
18	CA-MEN-2414H	Parlin Creek Trestle 1	200-ft standing in 1991; collapsed, removed since then	Not significant	2, 3
19	CA-MEN-2423H (P-23-002119)	Parlin Creek Trestle 2	200-ft standing in 1991; collapsed, removed since then	Not significant	2, 3
20	CA-MEN-ISO-25	Waldo – Isolate - wooden box constructed on skids - function unknown	Fair condition	Not significant	2, 3
21	CA-MEN-ISO-26	Isolate - medicine bottle, may date to 1900	Collected	Not significant	2, 3
22	CA-MEN-ISO-27	Isolate - Chock Block Assembly - hand forged, 1900?	Collected	Not significant	2, 3
23	CA-MEN-ISO-28	Isolate - Skids - two hand forged iron skids	Collected	Not Significant	2, 3
24		Camp 1	No historic remains noted, site of egg collecting station and modern campground	Potentially eligible – 1, 4	2, 3

10-B. NOTED AND RECORDED HISTORIC PERIOD HERITAGE RESOURCES IN JDSF					
IHR #[1]	**Trinomial (Primary #)**	**Description**	**Condition, Impacts Noted[2]**	**Significance/ Criteria[3]**	**References[4]**
25		Camp 2	Unknown condition; area bulldozed in 1989	Potentially eligible – 1, 4	2, 3
26		Camp 3 - large stumps with axe marks, no historic debris	Unknown	Potentially eligible – 1, 4	2, 3
27		Camp 4 - historic artifacts	Vandalized, collected	Potentially eligible – 1, 4	2, 3
28		Camp 5 - no evidence of logging camp	Site of modern Conservation Camp, terrain modified	Unknown	2, 3
29		Camp 7 - no historic evidence	Dense vegetation hindered reconnaissance	Unknown	2, 3
30		Camp 8 - ceramic fragments, cross ties	Unknown	Unknown	2, 3
31		Camp 9	Unknown	Unknown	2, 3
32		Camp10	Unknown	Unknown	2, 3
33		Camp 11	Unknown	Unknown	2, 3
34		Camp 12 - trash scatters? Steam donkey platform?	Unknown	Unknown	2, 3
35		Camp 13	Unknown	Unknown	2, 3
36		Camp 14 - sparse historic trash scatter	Not field checked	Potentially eligible – 1, 4	
37		Camp 15	Unknown	Unknown	2, 3
38		Camp 16	Not field checked	Unknown	2, 3
39		Camp 17 - possible privy pit	Unknown	Unknown	2, 3
40		Camp 18 - historic debris, fence line	Unknown	Potentially eligible – 1, 4	2, 3
41		School House - constructed 1915, built on skids, moved from camp to camp	Fair	Determined significant by CDF; selected for preservation – 1, 3	2, 3
42		Steam Donkey - mounted on sleds, on display at Camp 20	Good, should be recorded to HABS/HAER standards	Potentially eligible – 1, 3	2, 3
43		Tie Camp 1 - difficult to relocate, one possible historic artifact	Unknown	Unknown	2, 3
44		Tie Camp 2 - no physical evidence	Unknown	Unknown	2, 3
45		Tie Camp 3 - buttressing timbers of collapsed bridge	Unknown	Unknown	2, 3
46		Tie Camp 4	Not field checked	Unknown	2, 3

10-B. NOTED AND RECORDED HISTORIC PERIOD HERITAGE RESOURCES IN JDSF					
IHR #[1]	**Trinomial (Primary #)**	**Description**	**Condition, Impacts Noted[2]**	**Significance/ Criteria[3]**	**References[4]**
47		Tie Camp 5	Not field checked	Unknown	2, 3
48		Camp A - stumps cut prior to chainsaw, no other historic evidence	Impacted by modern campground (Camp #1)	Unknown	2, 3
49		Camp B, large clearing, large stumps, no other historic evidence	Unknown	Unknown	2, 3
50		Camp C, large clearing, trestle supports in streambed	Unknown	Unknown	2, 3
51		Camp D	Not field checked	Unknown	2, 3
52		Camp E - sparse scatter of tin cans and glass (same site as IHR #14 and #52?)	Area reforested in 1950s, historic camp destroyed?	Probably not significant	2, 3
53		Camp F, wood cribbing for rail siding, sparse scatter of historic trash	Area reforested	Unknown	2, 3
54		Camp G - no historic evidence, area overgrown with eucalyptus, pine plantation, manzanita	Unknown	Unknown	2, 3
55		Camp H	Not field checked	Unknown	2, 3
56		Camp I	Not field checked	Unknown	2, 3
57		Camp J	Not field checked	Unknown	2, 3,
58		Camp K - no historic evidence	Unknown	Unknown	2, 3
59		Boulton's	Not field checked	Unknown	2, 3
60		Berry's - no historic evidence, heavily overgrown with Scotch Broom	Unknown	Unknown	2, 3
61		Milliken's - no historic evidence	Unknown	Unknown	2, 3
62		Blast Camp (the 'Rock Pit'), former rock quarry now in reuse, collapsed shaft in vicinity	Unknown	Potentially eligible – 1, 3	2, 3
63		Barney's - no historic evidence	Modern campground	Probably not significant	2, 3
64	CA-MEN-2669H	Cully's Bar - site record not available	?	?	2, 3
65		Blacksmith's Shop - Camp C - iron objects noted	Unknown	Unknown	2, 3
66		Caspar Orchard - no evidence of orchard	Area logged; Eucalyptus, pine planted	Unknown	2, 3

10-B. NOTED AND RECORDED HISTORIC PERIOD HERITAGE RESOURCES IN JDSF					
IHR #[1]	**Trinomial (Primary #)**	**Description**	**Condition, Impacts Noted[2]**	**Significance/ Criteria[3]**	**References[4]**
67		Grave 1, grave of Jeff Hastey (d. 1877)	Original headboard replaced	Potentially eligible – 1, 2	2, 3
68		Grave 2	Not field checked	Unknown	2, 3
69	CA-MEN-2926H (P-23-002565)	Redwood oil tank, railroad grade, spur lines, Lincoln log trestles	Majority of main line converted to Road 300; ties and rails salvaged	Potentially eligible – 1, 3	2, 3
70		House - no historic evidence	Area heavily overgrown	Potentially eligible – 1, 4	2, 3
71		Train Wreck - no evidence		Probably not significant	2, 3
72	CA-MEN-2952 (P-23-002699)	Train Tunnel constructed by Caspar Lumber Company in 1903	Ends of tunnel are sealed; bore believed to be open; natural erosion	Potentially eligible – 1, 3	2, 3
73		Bridge 1 - no evidence noted		Probably not significant	2, 3
74		Bridge 2 - constructed by CDF in 1950s or 1960s, redwood construction with concrete footings		Potentially eligible - 1	2, 3
75		Bridge 3 - field checked but notes not included in Gary and Hines (1993)	Unknown	Unknown	2, 3
76		Bridge 4	Burned during undergrowth burn or destroyed intentionally?	Not significant	2, 3
77		Shed 1 - engine shed for repairs, historic artifacts noted	Partial deterioration	Potentially eligible – 1, 3, 4	2, 3
78		Shed 2 - unable to relocate	Unknown	Unknown	2, 3
79		Donkey site	Not field checked	Unknown	2, 3
80		Dump 1 - same as IHR#25			
81		Dump 2	Not field checked	Unknown	2, 3
82		Dump 3	Not field checked	Unknown	2, 3
83		Dump 4	Not field checked	Unknown	2, 3
84		H. Land Site	Not field checked	Unknown	2, 3
85		Soda Springs 1	Not field checked	Unknown	2, 3
86		Soda Springs 2	Not field checked	Unknown	2, 3
87		Mud Springs - dwelling site	Not field checked	Unknown	2, 3
88		Whiskey springs - Parlin Conservation Camp residence site	Unknown	Unknown	2, 3
89		Lake 1	Not field checked	Unknown	2, 3

10-B. NOTED AND RECORDED HISTORIC PERIOD HERITAGE RESOURCES IN JDSF					
IHR #[1]	**Trinomial (Primary #)**	**Description**	**Condition, Impacts Noted[2]**	**Significance/ Criteria[3]**	**References[4]**
90		Lake 2	Not relocated	Unknown	2, 3
91		Splash Dam 1	Not field checked	Unknown	2, 3
92		Splash Dam 2	Not field checked	Unknown	2, 3
93		Splash Dam 3	Not field checked	Unknown	2, 3
94		Trail	Not field checked	Unknown	2, 3
95		Incline 1 - trace of cut noted, no machinery	Not noted	Potentially eligible – 1, 3	2, 3
96		Incline 2 - evidence found but not described in Gary and Hines (1993)	Not noted	Potentially eligible – 1, 3	2, 3
97		Incline 3	Not field checked	Unknown	2, 3
98		Incline 4	Not field checked	Unknown	2, 3
99	CA-MEN-2901H (P-23-002525)	Incline 5 - linear groove in the landscape resulting from using an incline rail system to yard logs ca. 1940	Natural erosion	Potentially eligible – 1, 3	2, 3
100	CA-MEN-2902H (P-23-002526)	Incline 6 - linear groove in the landscape resulting from using an incline rail system to yard logs ca. 1940	Natural erosion	Potentially eligible – 1, 3	2, 3
101		Incline 7	Not field checked	Unknown	2, 3
102		Incline 8 - grade, historic artifact, trestle remains at end of grade	Not noted	Potentially eligible – 1, 3	2, 3
103		Incline 9	Destroyed by recent logging	Not significant	2, 3
104	CA-MEN-2305H	Bear Gulch A - same as IHR#12 (above)			
105		Bear Gulch B - fence line noted	Not noted	Probably not significant	2, 3
106		Bear Gulch C - wood structural remains, topped redwood trees, historic artifacts	Not noted	Potentially eligible - 1, 4	2, 3
107		Bear Gulch D - crosscut saw remains	Not noted	Probably not significant	2, 3
108		Bear Gulch E - unidentifiable machine parts strewn on hillside	Not field checked by Gary and Hines (1993)	Unknown	2, 3,
109		Bear Gulch F - 3 large possible donkey parts	Disturbed by prior logging	Probably not significant	2. 3

10-B. NOTED AND RECORDED HISTORIC PERIOD HERITAGE RESOURCES IN JDSF					
IHR #[1]	**Trinomial (Primary #)**	**Description**	**Condition, Impacts Noted[2]**	**Significance/ Criteria[3]**	**References[4]**
110		Bear Gulch Trestle 1 - single log across creek with one end support	Not noted	Potentially eligible – 1	2,3
111		Bear Gulch Trestle 2 – 60-ft double span	Not noted	Potentially eligible – 1, 3	2, 3
112		Bear Gulch Trestle 3 – collapsed	Poor condition	Potentially eligible – 1	2, 3
113		Bear Gulch Trestle 4 - bank shoring not a trestle	Not noted	Potentially eligible – 1, 3	2, 3
114		Bear Gulch Trestle 5 - single span	Not noted	Potentially eligible – 1, 3	2, 3
115		Bear Gulch Trestle 6 – 37-ft double span, fence, skid trail	Not noted	Potentially eligible – 1, 3	2, 3
116		Bear Gulch Trestle 7 – 27-ft double span	Not noted	Potentially eligible – 1, 3	2, 3
117		Bear Gulch Trestle 8 – 20-ft single span	Not noted	Potentially eligible – 1, 3	2, 3
118		Bear Gulch Trestle 9 - single span in place	Partially collapsed	Potentially eligible – 1	2, 3
119		Bear Gulch Trestle 10 - two spans	Collapsed	Potentially eligible – 1	2, 3
120		Bear Gulch Trestle 11 – 226-ft double span - age unknown	Excellent condition	Potentially eligible – 1, 3	2, 3
121		Trestle 1 - single set of pilings remain	Deteriorated	Probably not significant	2, 3
122		Trestle 2 - no evidence noted		Unknown	2, 3
123		Trestle 3	Not field checked	Unknown	2, 3
124		Trestle 4 - trestle remains, primarily supports	Extends a fair distance along ravine	Potentially eligible – 1, 3	2, 3
125		Trestle 5 - remnants of collapsed trestle	Deteriorated	Probably not significant	2, 3
126		Trestle 6 - standing portion of trestle	Not noted	Potentially eligible – 1	2, 3
127		Trestle 7 - collapsed portion of trestle	Not noted	Potentially eligible – 1	2, 3
128		Cribbing 1 - massive pair on both sides of stream	Intact	Potentially eligible – 1, 3	2, 3
129		Cribbing 2 - on one side of creek	Poor condition	Probably not significant	2, 3
130		3-Chop Trestle 1 – 100-ft pile trestle	Not noted	Potentially eligible – 1, 3	2,3
131		3-Chop Trestle 2	Well preserved	Potentially eligible – 1, 3	2, 3
132		3-Chop Trestle 3	Poor condition	Potentially eligible – 1	2, 3
133		3-Chop Trestle 4	Good condition	Potentially eligible – 1, 3	2, 3
134		3-Chop Trestle 5	Poor condition	Potentially eligible – 1	2, 3

10-B. NOTED AND RECORDED HISTORIC PERIOD HERITAGE RESOURCES IN JDSF					
IHR #[1]	**Trinomial (Primary #)**	**Description**	**Condition, Impacts Noted[2]**	**Significance/ Criteria[3]**	**References[4]**
135		3-Chop Trestle 6	Good condition	Potentially eligible – 1, 3	2, 3
136		3-Chop Trestle 7	Ends standing, center portion collapsed	Potentially eligible – 1, 3	2, 3
137		3-Chop Trestle 8 – short span trestle	Intact	Potentially eligible – 1, 3	2, 3
138		3-Chop Trestle 9	In good repair	Potentially eligible – 1, 3	2, 3
139		3-Chop Trestle 10 – 150-ft	Not noted	Potentially eligible – 1, 3	2, 3
140		3-Chop Trestle 11 – 207-ft	Not noted	Potentially eligible – 1, 3	2, 3
141		3-Chop Trestle 12	Not noted	Potentially eligible – 1, 3	2, 3
142		3-Chop Trestle 13 - 50 ft	Good condition	Potentially eligible – 1, 3	2, 3
143		Tin Can 1 Camp - no historic artifacts, hand cut stumps	Modern campground	Unknown	2, 3
144		Tin Can 2 Camp - no historic artifacts	Modern campground	Unknown	2, 3
145		Noyo Trail Trestle	Not field checked	Potentially eligible – 1	2, 3
146		Tin Can Camp 1 - historic ceramics	Modern campground	Unknown	2, 3
147		Spur Line, Tin Can Camp 2 - grade, no ties or tracks	Not noted	Potentially eligible – 1	2, 3
148		Ties in creek bed	Not noted	Unknown	2, 3
149		Cribbing for trestle bridge - both sides intact	Not noted	Potentially eligible – 1, 3	2, 3
150		Trestle with wood cribbing both ends	Now used as foot bridge	Potentially eligible – 1, 3	2, 3
151		Wood trestle - date uncertain (possibly constructed in historic style)	Excellent condition, currently used as road bridge	Potentially eligible – 1, 3	2, 3
152		Trestle bridge - date uncertain (possibly constructed in historic style)	Excellent condition, currently used s road bridge	Potentially eligible – 1, 3	2, 3
153		Trestle - not described	Not noted	Potentially eligible – 1, 3	2, 3
154		Tom's Steam donkey - not described	Not noted	Potentially eligible – 1, 3	2, 3
155		Trestles A & B; 75-100-ft-long	Not noted	Potentially eligible – 1, 3	2, 3
156	CA-MEN-2659H	Historic remains of landing or portable mill site - wood 'foundations', possible rail spur	Area appears to have been 'cleaned up'	Potentially eligible – 1, 3	2, 3
157		Trestles (3), Railroad Bed (1), stack of ties	Not noted	Potentially eligible – 1, 3	2, 3

10-B. NOTED AND RECORDED HISTORIC PERIOD HERITAGE RESOURCES IN JDSF					
IHR #[1]	**Trinomial (Primary #)**	**Description**	**Condition, Impacts Noted[2]**	**Significance/ Criteria[3]**	**References[4]**
	CA-MEN-2860H (P-23-002444)	Railroad grade - 1.0-mi.-long, trestle supports	Natural erosion	Potentially eligible – 1, 3	
	CA-MEN-2861H (P-23-002445)	Base logs of a splash dam	Natural erosion	Potentially eligible – 1, 3	
	CA-MEN-2862H (P-23-002446)	Homestead site - subsurface cellar, collapsed cabin debris, historic artifacts	Natural erosion, looting	Potentially eligible – 4	
	CA-MEN-2900H (P-23-002524)	Campsite - tent platform, domestic historic artifacts, outhouse	Looting?	Potentially eligible – 4	
	CA-MEN-2903H (P-23-002527)	Large rectangular pit - reservoir?	To be filled in by CDF and used as road bed	Unknown	
	CA-MEN-2904H (P-23-002528)	Portions of Three-Chop Railroad, trestles, associated historic artifacts	Range of condition, much of original system removed (salvaged)	Potentially eligible – 1, 3	
	(P-23-002535)	Isolate - whiskey bottle	Collected	Not significant	
	(P-23-002536)	Isolate - whip saw	Collected?	Not significant	
	CA-MEN-2913H (P-23-002539)	Portions of Hare Creek Railroad, remnants of trestles and cribbing,	Portions converted into Road 450, portions salvaged	Potentially eligible – 1, 3	
	(P-23-002549)	Isolate - double walled metal box, openings for pipe fittings - originally installed over stream, for steam donkey?	Not collected	Unknown	
	CA-MEN-2924 (P-23-002563)	Logging camp (part of Camp 1?) - structure pads, light scatter of historic artifacts	Heavily looted	Unknown	
	CA-MEN-2925 (P-23-002564)	Logging Camp (part of Camp 1?) - sparse scatter of historic artifacts	Erosion, looting	Unknown	
	(P-23-002683)	Railroad grade, trash scatter, pit - 1920s	Not noted	Unknown	

10-B. NOTED AND RECORDED HISTORIC PERIOD HERITAGE RESOURCES IN JDSF

IHR #[1]	Trinomial (Primary #)	Description	Condition, Impacts Noted[2]	Significance/ Criteria[3]	References[4]
	(P-23-002800)	Hare Creek Railroad spur line	Erosion	Potentially eligible – 1	
	(P-23-003283)	North Fork/South Fork Noyo River standard gauge railroad constructed mostly on elevated trestles- 1.25-mi segment, scattered trestle sections	Not noted	Potentially eligible – 1, 3	
	(P-23-003340)	Hand constructed trail, 2 sections - 1939			
	(P-23-003587)	350-ft section of historic railroad grade - log stringers and cribbing, spikes	Not noted; much of remainder of remainder of grade converted to truck road	Potentially eligible – 1, 3	
	(P-23-003588)	Split redwood rail fence (part of Camp 16?) '	40% of fence remains	Potentially eligible – 1	
	(P-23-003607)	Isolate -heavy ore or freight wagon wheel	Collected	Not significant	

1) IHR: Inventory of Historic Resource number as assigned by Gary and Hines, 1993
2) Information about when impacts from past logging, road construction and vandalism occurred is not documented. Some impacts have occurred prior to Forest ownership by CDF; some during CDF ownership
3) Significant/eligible for California Register of Historical Resources under criteria 1, 2, 3, 4 (see above)
4) References: 1 = Levulett and Bingham 1978
   2 = Gary and Hines 1993
   3 = Medin 1994
   4 = Betts 1999

10-C. SUMMARY OF RECORDED AND KNOWN HISTORIC SITES, STRUCTURES, AND OBJECTS BY TYPE

Property Type	Expected Remains	IHR #[1]	Total Sites Known and Recorded
SITES			
Logging Camps	refuse deposits, architectural remains, tent pads, railroad grades, machinery	1, 4, 5, 6, 7, 10, 12, 14, 17, 24-40, 43-58, 65, 80, 104, 106, 143, 144, 146, 156	50
Homesteads	refuse deposits, architectural remains	8, 59, 60, 61, 63, 64, 70, 87	8
Refuse Scatters	glass, ceramic, tin, no structural remains	81-84, 108, 109	6
Gravesites	headboard, human remains	67, 68	2
BUILDINGS			
Schoolhouse	red, wood frame, shiplap siding	41	1
Cat Barn	wood frame, shiplap siding, shake shingles	11	1
Sheds	wood framing, wood lined pit	77, 78	2
STRUCTURES			
Trestles	timbers, milled wood, collapsed or standing, cribbing	2, 9, 18, 19, 73-76, 110-142, 145, 149-153, 155, 157	49
Railroad Grades	ties, "ribbing," road cut, linear depression	147	1
Incline Tramways	linear depression, road cut, wood ties	16, 95-103, 148	11
Skid Roads	ties, road cut, linear depression		0
Tank	redwood oil tank	69	1
Donkey Platforms	wire, cable around stumps, skid roads, ground modification	42, 79, 154	3
Tunnel	(collapsed)	72	1
Dams	wooden cribbing	91, 92, 93	3
Lakes	catchment basin	89,90	2
Fences	posts, wires	105	1
Cairns	rocks, no refuse	15	1
Rock Quarries	small collapsed shaft	62	1
OBJECTS			
Isolated Artifact	Individual bottles, logging tools, and/or equipment	13, 20-23, 107	6
OTHER[2]			
Orchards	apple trees	3, 66	2
Springs	natural spring	65, 86, 88	3
Trails	remnant path	94	1
Unknown	unknown function or no remains present	71	1
		TOTAL	**157**

1) IHR: Inventory of Historic Resource number as assigned by Gary and Hines, 1993
2) "Other" is a catch-all category and includes properties that do not fit under the specific types.
(Source: Medin 1994: Table 3.1)

10-D. SUMMARY OF ARCHAEOLOGICAL AND ARCHIVAL COLLECTIONS FOR JDSF

ARCHAEOLOGICAL COLLECTIONS

Repository	Type of Collection	Site Provenience	Notes	References
Mendocino County Museum, "Roots of Motive Power" exhibit, Willits	Steam donkey	N/A (JDSF)	On loan from CDF	Foster and Thornton 2001:69
City of Fort Bragg	"Daisy," an original steam locomotive of Caspar Lumber Company	N/A (JDSF)	On loan from CDF	Foster and Thornton 2001:69
JDSF Head-quarters, Ft. Bragg	Glass bottles, ceramics, hardware, logging equipment, prehistoric artifacts?	Undocumented (JDSF)		2/7/02 site visit by authors
CDF Northern Field Office, Santa Rosa	Logging camp items, prehistoric artifacts	CA-MEN-790/H, -1367, -1371	Items #515, #518, #519 in inventory by Foster (2001)	Foster 2001
CDF Main Office, Sacramento	Chert and obsidian flakes and tools, stone plummet	CA-MEN-790/H, -1360, -1361, -1362, -1365, -1367, -1370, -1371, -1693, -2893, -3017, -3019	Items # 63-#74, #88 in inventory by Foster (2001)	Betts 1999; Foster 2001
California Department of Parks & Recreation, Archaeology Lab, Sacramento	Undetermined			
San Jose State University	Approx. 10 groundstone artifacts, 36 flaked stone artifacts, 1 clay/rock artifact, 4 lbs. Chipping debris, 200 historic/ modern items, <10 organic materials	CA-MEN-790/H (Three Chop Village)	Item #664 in inventory by Foster (2001); collections from excavations	Layton 1990; Foster 2001
Mark Gary Estate	Undetermined			

10.E STATE LAWS, REGULATIONS, STANDARDS AND GUIDELINES

Heritage Resource Inventories and Preservation Program Requirements for State Agencies

- *California Governor Pete Wilson's 1992 Executive Order W-26-92 (State Policy for Heritage Resources)* directs all state agencies, including CDF, to implement programs and policies for the protection and management of California's significant heritage resources, to consult with the State Historic Preservation Officer (SHPO), and to appoint an Agency Preservation Officer (for CDF, Senior State Archaeologist Dan Foster is the current appointment), within existing budget and personnel resources.
- *California Public Resources Code (PRC) Sections 5020 through 5024 (Historical Resources)* provides powerful authority and responsibilities for all state agencies, including CDF, for the protection of heritage resources. It establishes the powers and duties of the State Historical Resources Commission and the SHPO, defines important terms, and provides state policy for inventories and preservation programs. It requires state agencies to implement plans and protection programs, and to consult with the SHPO prior to any project that could result in substantial adverse change to the significance of a state-owned cultural resource. The 1992 amendment established the California Register of Historical Resources and its implementing regulations.
- California Environmental Quality Act, PRC Sections 21083.2 and 21084.1 (CEQA Statutes), and the implementing regulations (CEQA Guidelines) at Title 14 California Code of Regulations (CCR) Sections 15064.5 through 15360, address the protection of historical resources (i.e., a resource listed or eligible for listing in the California Register of Historical Resources), requiring lead agencies to determine whether projects may cause a substantial adverse change in the significance of a historical resource in the environmental review process. Note that the former CEQA Appendix K has been deleted, with relevant guidance incorporated into the revised Guidelines that became effective on January 1, 1999.

Protection of Native American Graves (Public and Private Lands), and Protection and Access by Native Americans to Native American Traditional Heritage Resources on State Lands

- *PRC Section 5097.9 (Native American Historical, Cultural, and Sacred Sites)* authorizes creation of the Native American Heritage Commission, establishes its powers and duties, requires state agency cooperation, prohibits impacts to Native American graves, sacred and religious sites located on state lands, promotes access by Native Americans to such places on state lands, and establishes notification procedures following inadvertent discovery of Native American remains on state or private lands. It also prohibits unauthorized possession of Native American skeletal remains and associated grave goods, punishable under a felony offense, and sets forth policy for repatriation of said remains and goods to the Most Likely Indian Descendent. This PRC Section provides statutory authority for Native American

Notification procedures in the Forest Practice Rules, and the direction for notification policy for CDF projects during cultural resource impacts analyses conducted by CDF.

Repatriation of Native American Human Remains and Cultural Items Held by State Agencies and Museums

- *Health and Safety Code Sections 8010-1030* requires all state agencies and museums that receive state funding and have possession of or control over collections of human remains or cultural items, as defined, to complete inventories with the objective of returning such items to the appropriate linear descendent or culturally affiliated Indian tribe, whether or not such tribe is federally recognized. This law establishes a 10-member Repatriation Oversight Commission, with specified duties relating to the repatriation process, including assistance to ensure that state agencies and museums are responding to claims under either State or Federal NAGPRA laws in a timely manner.

Confidentiality of Heritage Resource Locations

- *Government Code Section 6254.10 (Exception to the California Public Records Act)* recognizes that providing cultural resource location information to the general public may put such resources at risk from illicit relic-hunting, excavations or vandalism, exempts archaeological site information from the California Public Records Act, and provides authority for widespread state policy to keep archaeological site information confidential.

Regulations and Standards for Managing Historic Buildings

- *Health and Safety Code Sections 18950 through 18961 (State Historical Building Code*) provide alternative regulations and standards for the repair, restoration and management of historic buildings as defined in PRC 5024.

Standards for Documenting Heritage Resources

- *Instructions for Recording Historical Resources*, with the corresponding record forms (DPR 523 series), comprise the current required format for formally recording heritage resources in California (OHP 1995), with the records housed at the regional Information Centers of the California Historical Resources Information System. CDF's professional archaeologists and certified RPFs consistently use these forms to formally record sites.

Standards for Reporting Heritage Resource Studies

- "Archaeological Resources Management Reports (ARMR): Recommended Contents and Format," Preservation Planning Bulletin Number 4(a), provides guidance for the preparation and review of archaeological reports OHP (1989).

Preparation of Archaeological Research Designs

- *"Guidelines for Archaeological Research Designs," Preservation Planning Bulletin Number 5,* offers recommended standards from OHP (1991) for preparing archaeological research designs to guide studies (especially excavation projects) designed to evaluate site significance or to mitigate impacts where site avoidance is not feasible.

Programmatic Approaches to Managing Certain Archaeological Site Types

- *California Archaeological Resource Identification and Data Acquisition Program [CARIDAP]: Sparse Lithic Scatters* (Jackson et al. 1988), adopted by the OHP as a programmatic approach to defining, recording and managing this specific archaeological resource type. As set forth by Jackson et al. (1988:1):

9F. FEDERAL LAWS, REGULATIONS, STANDARDS, AND GUIDELINES

Address Impacts to Heritage Resources Affected by Federal Undertakings

- Section 106 of the National Historic Preservation Act (1966, as revised through 1992) and its Implementing Regulations at 36 CFR 800 (Protection of Historic Properties) requires Federal agencies take into account the effects of their actions on "historic properties" (defined as "… any prehistoric or historic district, site, building, structure or object included in, or eligible for inclusion on the National Register of Historic Places, including artifacts, records, and material remains related to such a property…" (NHPA Section 301[5]), and afford the Advisory Council on Historic Preservation a reasonable opportunity to comment. Federal "actions" are defined under the statute as: a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or behalf of a Federal agency; those carried out with Federal financial assistance; those requiring a Federal permit, license or approval; and those subject to State or local regulation administered pursuant to a delegation or approval by a Federal agency.

Impacts to Heritage Resources Addressed by Environmental Reviews (NEPA)

- *National Environmental Policy Act of 1969 (NEPA)* requires Federal agencies to consider all impacts on all aspects of the environment before decisions are made about projects that may significantly affect the quality of the human environment. Generally, analysis of impacts to heritage resources involves coordination with the NHPA Section 106 process.

Repatriation of Native American Cultural Items

- *Native American Graves Protection and Repatriation Act of 1990* applies to CDF because the agency meets the statutory definition of a "museum" (entity that has received Federal funds) (Foster and Thornton 2001:47). NAGPRA requires that "museums" search their collections to inventory human remains, grave goods, sacred items and objects of cultural patrimony, notify potential culturally affiliated Federally Recognized Tribes, and repatriate cultural items where the legal mandates are met.

Comprehensive Standards and Guidelines for Heritage Resources Management

- *Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation* (USDI 1983) provide technical advise to Federal, State and local agencies in conducting a comprehensive approach to identifying, evaluating, registering, and treating heritage resources across the nation. This fundamental reference addresses preservation planning, professional qualifications, and identification, evaluation, registration and documentation of archaeological, historical and historic architectural resources.

APPENDIX 11
HYDROLOGY AND WATER QUALITY

1. PEAK FLOWS

In 1998, peak flow studies on Caspar Creek were presented as being consistent with the results from studies conducted over the past several decades throughout the Pacific Northwest. That is, the greatest effect of logging on streamflow peaks is to increase the size of the smallest peaks occurring during the driest antecedent conditions, with that effect declining as storm size and watershed wetness increases (Ziemer 1998). The effect of logging on stormflow response in Caspar Creek was considered relatively benign, with no apparent changes to modify channel morphology or increase the frequency of landsliding.

Characterization and quantification on storm runoff and suspended sediment was done through exploratory analysis and model fitting of the North Fork Caspar Creek data with respect to the effects of watershed disturbances, watershed area, antecedent wetness, and time since disturbance (Lewis et al. 2001). The results were consistent with Ziemer's previous findings, but the modeling results provided further discussion of the cause and effects of logging on stormflows:

Logging influenced both storm peaks and flow volumes via the same mechanisms: reduction of rainfall interception and transpiration. The models for stormflow peaks and volumes showed that flow increases could be largely explained by the proportion of a watershed logged, an antecedent wetness index, and time since logging. The recovery rate of about 8% per year for storm peaks supported the hypothesis that changes in peak flows are largely controlled by changes in vegetation.

Averaged increases in annual storm runoff were 58 percent from watersheds that were entirely (95-100%) clearcut, and 23 percent from watersheds that were 30 to 50 percent clearcut, with the highest increases occurring with the smallest peaks during the driest antecedent conditions. Relative increases in storm discharge peaks and volumes declined with storm size but were positive even in the largest storm of the study period (recurrence interval of seven years at the North Fork confluence). The mean percentage increase in peak flow leveled at an average increase of 35 percent in clearcuts and 16 percent in partially cut watersheds for peaks greater than 0.004 $m^3s^{-1}ha^{-1}$ (return periods longer than 0.5 years). The two-year storm had an averaged peak flow increase of 27 percent in clearcut watersheds. Storm runoff volumes had similar, though slightly less, percentage increases than peak flow.

Accounting for the amount of watershed disturbance, there was no evidence that either storm peaks or the logging effect on peaks was related to watershed size. Peaks in the smallest drainages tended to have greater responses to logging than in larger watersheds, but this was because the smaller watersheds had greater proportions disturbed. Effects of multiple disturbances on storm discharge peaks and volumes were approximately additive, and there was little evidence for magnification of effects downstream.

Forest Practice Rules and economics usually limit the amount of intense activity occurring within any given watershed in any year. Therefore, it is possible for entire small first-order watersheds to be logged within a single year. However, as the size of the watershed increases, a smaller

proportion of the watershed is likely to be logged in any given year. In the largest watersheds, harvesting may be spread over decades, within which time the earliest harvested areas will have revegetated.

Peakflow increases in Caspar Creek were primarily a function of vegetation removal (Lewis et al. 2001). Peakflow increases are also influenced by roads from both compacted area and routing, particularly in small drainages that have new road construction, which often directs extra water into small channels. However, as the majority of the road network has already been constructed, and with limited new construction anticipated, this peakflow analysis focuses primarily on harvest related increases. This analysis utilizes the methodology of the USFS Redwood Sciences Lab, Review of Freshwater Flooding Analysis (Lisle et al. 2000). These were the steps involved:

1. **Identify acreages of logging a methods used.** From the GIS from JDSF, past logging, acreages, and silviculture were obtained. For this analysis, harvests conducted from 1980 to 1999 were used.

2. **Calculate equivalent canopy removal.** The area of equivalent canopy removal for each THP was estimated by assuming that 100% of the canopy is removed by clearcutting (CLCT); 75% of the canopy is removed during diameter limit cuts (DL22), shelterwood prep (SHPC), shelterwood step cut (SHSC), and seedtree step (STSC) cuts (these cuts typically leave only a residual of large trees to regenerate the harvested acres); 50% of the canopy is removed from alternative prescriptions (ALPR), commercial thins (CMTH), sanitation savage (SASV), selection (SLCN), cluster selection (CSLC), and transitional (TRAN) cuts; and 25% of the canopy is removed in the JDSF group selection (GSLC) prescription, and the shelterwood and seedtree removal steps (SHRC and STRT), both which require regeneration of the previously harvested area prior to removal of residual trees. These silvicultural prescriptions are from JDSF information, and differ somewhat from the Freshwater prescriptions. Accordingly, the percent canopy removal may also differ from the Lisle (2000) report.

3. **Describe logging history.** The year of canopy change was assumed to be the year the THP was submitted for logging and listed as "YEAR" in the GIS layer.

4. **Tabulate canopy loss by year.** Each year's harvest acreage was calculated to determine the equivalent clearcut acres (ECA), also referred to as the equivalent canopy acres removed. This value was then divided by the total acres of JDSF (48,652) to determine proportion of canopy area removed.

   This approach was appropriate for forest wide analysis: when the equivalent canopy removal acres were determined for individual planning watersheds per year and divided by the total planning watershed acres, the percent planning watershed logged in a year averaged 3.39 percent with a median value of 2.79 percent; standard deviation of 2.71 percent. The highest ECA in a year was 14 percent (766 acres) in 1983 with the Diameter Limit Cut in the Upper North Fork Big River planning watershed. The maximum percentage ECA range in a planning watershed over a five-year period was 12 to 19; although James Creek planning watershed amounted to 26 percent from 1980-1984. Similarly, the maximum percentage ECA range over a 10-year period ranged from 15 to 26 percent.

5. **Define values for variable to be used in the peakflow change equation:**

$$\mathbf{r = Exp([1+B_2(t-1)]c[B_4+B_5ln(y_c)+B_6ln(w)])}$$

where:

r = ratio between the observed peak flow and the expected flow without a logging effect in a watershed.

B_2 , B_4 , B_5 , B_6 = logging recovery coefficient (-0.0771); constant (1.1030); storm size coefficient (-0.0963), and watershed wetness coefficient (-0.2343), respectively.

t = number of summers since logging (here, calculated as calendar years before year for which calculations are being made).

c = proportion of the watershed logged

The equation (y_c = 0.0073 $m^3s^{-1}ha^{-1}$) was used in this analysis for y_c and is defined as the expected mean peak discharge (HI) of watersheds HEN and IVE (North Fork Caspar Creek) to a storm having the return period of the storm being estimated ($m^3s^{-1}ha^{-1}$). The equations used to determine this value was derived from the 2-year flow equation for the North Fork Caspar Creek (y_{nfc}) using the "partial-duration series" of the hydrograph peak data rather than the "annual-maximum series" because the annual maximum series tends to underestimate flows for recurrence intervals less than 10 years (Dunne and Leopold 1978) since it includes only the largest flow of the year. The value of y_{nfc} was calculated from:

$$\mathbf{y_{nfc} = 0.006731 + 0.003271\ \mathit{Ri} + 0.0002256\ \mathit{Ri}^2}$$

where ***Ri*** is the recurrence interval of the flow in years. The resulting value for y_{nfc} is then used in the following equation to calculate y_c:

$$\mathbf{y_c = (1.0185\ y_{nfc})^{1.0508}}$$

which results in a value of 0.0073 $m^3s^{-1}ha^{-1}$ for y_c. The Redwood Sciences Lab examined 15 years of flow records and found that the measured 2-year flow for HI using annual maximums is about 0.0083 $m^3s^{-1}ha^{-1}$. However, because the peakflow change equation (shown at the start of step 5) produces estimates of proportional changes rather than magnitudes, results are not very sensitive to the magnitude of y_c, and results using either the annual-maximum or partial-duration series agree well with one another.

The watershed wetness index (w) was determined using the equation,

$$\mathbf{w = 30.081\ \mathit{Ri} - 10.093}$$

to calculate the "minimum" wetness index for a 2-year storm. This gives a wetness value of 50 for dry antecedent moisture conditions, which is a worst-case assumption that leads to the largest predicted percentage increase in peakflow. Examination of the peakflow and wetness data from Caspar Creek by the Redwood Sciences Lab suggests that only about six percent of the 2-year flows would be expected to occur at lower wetness values.

6. **Apply equation to calculate effects of past logging.** Utilizing the values described above, Table 11A provides an example of the peakflow increase for 1999.

Here the peakflow change predicted using the equation in Step 5 calculates the proportional change relative to unlogged condition; these values are converted to percentage increases (e.g. an observed change in the peakflow ratio of 1.0003 is equivalent to a 0.03% increase), are then summed to give a total percentage increase in peak flow.

TABLE 11A
CALCULATION OF THE ESTIMATED INCREASE IN PEAKFLOW FOR THE 2-YEAR STORM RETURN INTERVAL UNDER DRY SOIL MOISTURE CONDITIONS FOR THE YEAR 1999.

Year Logged	Equivalent Canopy Acres Removed	Proportion of JDSF (48,652 acres) logged	Summers Since Logged	Observed/ Expected Peakflow Ratio	Resulting Peakflow Change (%)
1980	468	0.00962	19		
1981	473	0.00972	18		
1982	971	0.01996	17		
1983	1314	0.02701	16		
1984	240	0.00493	15		
1985	560	0.01151	14	0.99998	-0.002
1986	709	0.01457	13	1.00072	0.072
1987	333	0.00684	12	1.00069	0.069
1988	680	0.01398	11	1.00211	0.211
1989	435	0.00894	10	1.00181	0.181
1990	402	0.00826	9	1.00209	0.209
1991	719	0.01478	8	1.00450	0.450
1992	399	0.00820	7	1.00291	0.291
1993	260	0.00534	6	1.00217	0.217
1994	469	0.00964	5	1.00441	0.441
1995	1317	0.02707	4	1.01383	1.383
1996	1147	0.02358	3	1.01325	1.325
1997	450	0.00925	2	1.00565	0.565
1998	267	0.00549	1	1.00363	0.363
1999	823	0.01692	0	1.01210	1.210
Total percent increase estimated for 1999 (summation of positive values):					**6.987 %**

This model takes 13 years to eliminate effects of peakflow changes or to stabilize future projections. Hence past peak flow increases with this data set can only be calculated back to 1993.

7. **Calculate effects of past logging, and estimate projections for alternatives.** Projections were calculated for the alternatives (results in Table 11B) using the following assumptions:

   Harvesting conducted in 2000 was similar to years past, and an average ECA was used from 1984 to 1999, assuming harvesting would be most similar to the last management plan. An ECA of 576 acres was used to represent year 2000. A canopy removal value of 166 acres was assigned for the small amount of harvesting occurred in 2001.

   Alternative A (No direct management activity): No harvests. Percent canopy removed on the forest would be zero per year.

   Alternative B (Management remains consistent with 1984 Management Plan): No silvicultural allocation applied to landbase, which could result in more evenaged management. The average of the highest ten years (1980-1999) proportion on the forest came to an ECA of 871 acres. This value was used uniformly in the future projection for Alternative B.

   Alternative C (Management consistent with the Draft Forest Management Plan): Harvests are conducted under silvicultural allocations of two-thirds the area available for timber management in unevenaged management, and one-third under evenaged management. More volume will be taken than in Alternative B, but the silviculture allocation plan for greater unevenaged management, which would possibly result in less percent canopy removed. The average canopy removal of the past record of years analyzed (1980-1999) came to an ECA of 622 acres. This value was used uniformly in the future projection for Alternative C.

   Alternative D (Citizens Advisory Committee): Harvests are conducted all under unevenaged management, and less volume is removed than from Alternatives B and C. Assumed percent canopy removed will drop to half of the past harvesting, which is half that of Alternative C. An ECA of 311 acres was applied uniformly in the projection analysis for this alternative.

   Alternative E (Late Seral Emphasis): Assumed harvest volume drops to half of Alternative D with the silvicultural prescription restricted to single tree selection to promote late seral development, which is an ECA of 155 acres. This value was applied uniformly in the projection analysis.

   Using these assumptions, and the methodology described above, Table 11B shows the peakflow values determined for past harvesting and peakflow increase projections for each alternative.

TABLE 11B
ESTIMATED PEAKFLOW INCREASES FOR THE 2-YEAR STORM RECURRENCE INTERVAL UNDER DRY SOIL MOISTURE CONDITIONS FOR THE PAST AND PROJECTED FUTURE WITH THE VARYING ALTERNATIVES ALTERNATIVES.

Alternative:		**A**	**B**	**C**	**D**	**E**
Year	Past	No Harvest	1984 Mgt. Plan	Draft Mgt. Plan	Citizens Adv. Comm.	Late Seral Emphasis
1993	5.7 %					
1994	5.5 %					
1995	6.6 %					
1996	7.4 %					
1997	7.1 %					
1998	6.6 %					
1999	7.0 %					
2000	7.0 %					
2001	6.3 %					
2002		5.5 %	6.8 %	6.4 %	5.9 %	5.7 %
2003		4.7 %	7.2 %	6.5 %	5.6 %	5.1 %
2004		4.0%	7.5 %	6.5 %	5.2 %	4.6 %
2005		3.3 %	7.8 %	6.5 %	4.9 %	4.1 %
2006		2.7 %	8.1 %	6.6 %	4.6 %	3.6 %
2007		2.1 %	8.4 %	6.6 %	4.3 %	3.2 %
2008		1.5 %	8.6 %	6.5 %	4.0 %	2.8 %
2009		1.0 %	8.7 %	6.5 %	3.8 %	2.4 %
2010		0.7 %	8.9 %	6.5 %	3.6 %	2.1 %
2011		0.4 %	9.1 %	6.6 %	3.5 %	2.0 %
2012		0.3 %	9.3 %	6.7 %	3.5 %	1.9 %
2013		0.1 %	9.4 %	6.7 %	3.4 %	1.7 %
2014		0.0 %	9.5 %	6.8 %	3.4 %	1.7 %
2015		0.0 %	9.6 %	6.8 %	3.4 %	1.7 %
After 13 years, values remain constant.						

Recent peakflow studies of the Caspar Creek (Lewis et al. 2001; Rice et al. 2001, and in press) have shown that peakflow response was proportional to the amount of watershed disturbance; that the mean percentage increase in peak flow leveled at an averaged increase of 35 percent in clearcuts and 16 percent in partially cut watersheds for peaks with return periods longer than 0.5 years; and the two-year storm had an averaged peak flow increase of 27 percent in completely clearcut watersheds, and nine percent for the 50 percent cut North Fork Caspar. In that regard, the peakflow values from model above fit within the range of values determined from the analysis of Caspar Creek peakflows, using assumptions based on the last 20 years harvesting.

Grant et al. (1999) summarized case studies on peakflows and confirmed that peakflow increases due to harvest activities are real (statistically significant) in both small and large basins, but are more easily detected in the smaller basins. Furthermore, that the effect of management appears to increase peakflows of small to moderate size (up to 2-year return intervals), but these changes are within the "normal" range of variability of streamflows, at least for westside Cascade streams.

However, little is known about the relation between the flow regime and ecosystem response. Ziemer (1998) stated that the effect of logging on stormflow response in Caspar Creek seemed to be relatively benign: the changes in streamflow (average peakflow increase of 27 percent in clearcuts and 9 percent in partially cut North Fork Caspar Creek for 2-year storm return interval) did not appear to have substantially modified the morphology of the channel (Lisle and Napolitano 1998) or the frequency of landsliding (Cafferata and Spittler 1998).

The assumptions made in this peakflow analysis were determined by intentionally using the high-end range of the values determined from the harvesting conducted over the last 20 years, and with dry antecedent soil moisture conditions, in the effort to obtain the upper range of the 2-year storm peakflow increases that may occur in a planning watershed due to harvest activities. In fact, for the peakflow studies of Casper Creek (Lewis et al. 2001), the 9 percent increase in the 2-year storm was for an ***average*** of many different moisture conditions, and would have been higher if the authors had used just the dry conditions. Using Lewis et al. (2001), it is estimated that the 9 percent increase would have been greater than a 30 percent increase if only the dry soil conditions were used (as was in the peakflow model). Similarly, for years with less harvesting than modeled, the calculated peakflow projection results would be less than predicted above. From this analysis, and the conclusions of past studies (Lewis et al. 2001, Grant et al. 1999, Ziemer 1998), it appears that the peakflow increase range of seven to 10 percent modeled in this analysis would be relatively benign. No adverse effects from peakflows are expected for any of the alternatives.

2. WATER QUALITY

TMDL

Section 303(d) of the Clean Water Act requires each State to prepare a list of waterbodies within its boundaries that do not meet water quality standards with existing management practices, and submit the list to the U.S Environmental Protection Agency (EPA) for approval. Once a body of water is added to a 303(d) list, a TMDL (total maximum daily load) for that water body is calculated to meet water quality objectives. A TMDL is the maximum amount of a given pollutant a waterway can absorb from all sources, plus a margin of safety, without violating water quality standards for designated uses such as drinking water, aquatic life, and recreation. Both the Noyo River and Big River are listed as sediment impaired and had TMDL dates of 1999 and 2001, respectively.

In 1999, the EPA established a TMDL for the Noyo River, and determined sediment loading allocations aimed at improving water quality criteria for sediment. The EPA acknowledged that the office-based sediment budget assessments used in TMDL were incompatible with field geomorphic relations (EPA 1999). In an unpublished study conducted on the South Fork Noyo River by William Lettis & Assoc. and Graham Matthews & Assoc., found that changes in the amount of sediment in long-term storage (up to 100 years old from historic logging practices) is a significant contributor to short-term suspended sediment load (Koehler et al. 2001).

From research conducted on the South Fork Noyo River (Koehler et al. 2001), sediment from historic logging practices (beginning over 100 years ago) have been stored and transported downstream over time. Their research showed that sediment trapped in long-term storage along the channel was transported downstream in high-discharge events; and that these events increased the overall suspended load, which could lead to an overestimation of the sediment generated by upslope

management practices. They recommended future sediment transport studies be designed to assess in-channel storage and transport to enable a better distinction between in-channel and upslope sediment sources in the evaluation of sediment budget analyses.

Sediment

Although erosion rates in the Coast Ranges are naturally high, management-related activities have accelerated the naturally high rates in many areas. Erosion from roads can be associated with road surfaces, road fills, or slope failures associated with road construction (e.g., blocked culverts). Timber harvesting often results in surface erosion from landings, skid trails, and other compacted areas (MacDonald et al. 1991; Moring 1982). Increased sediment yields tend to persist from slope failures and road surface runoff. Yet, implementation of improved Forest Practice Rules (FPR) and Best Management Practices (BMP) over the last 20 years is considered to have significantly decreased sediment input to streams relative to past practices (Cafferata and Spittler1998, Lewis 1998, CDF 1995, SWRCB 1987).

Streamside landslides, gully erosion, and debris flows are the major erosional processes delivering sediment to the Caspar Creek channel system. Based on debris basin surveys and suspended sediment measurements, the perennial, gravel-bed North Fork channel typically transports about 70 percent of its sediment load in suspension, and sand rarely exceeds 50 percent of the suspension. Gravel bars associated with woody debris jams and debris-induced bank erosion furnish the bulk of bedload transported during peak flows. Finer sediments cap the highest gravel bars and are stored in pools for transport during modest storm flows (Lisle and Napolitano 1998).

Characterization and quantification on suspended sediment and storm runoff was conducted through exploratory analysis and model fitting of the North Fork Caspar Creek data with respect to the effects of watershed disturbances, watershed area, antecedent wetness, and time since disturbance (Lewis et al. 2001).

The most important explanatory variable identified by the sediment models was increased volume of streamflow during storms after logging (e.g. after logging increased storm flows in the treated watersheds provide additional energy to deliver and transport available sediment). This was in contrast with the parallel model for storm flow volume, and suggests that some of the sediment increases were unrelated to flow increases.

Other variables found to be significant, depending on the control watersheds used, were road cut and fill area and length of unbuffered stream channel, particularly in burned areas. It is unknown how much of this hillslope erosion was delivered to stream channels, but the proportion of watershed burned was not a useful explanatory variable for suspended sediment transport. A plausible conclusion was that only burned areas in or adjacent to stream channels contributed appreciable amount of sediment to the streams.

In the range of data observed, the effect of flow on sediment loads was approximately additive. Meaning that the combined effect of multiple disturbances on sediment loads was very similar to the sum of the effects of the individual disturbances. None of the product terms were found to have coefficients significantly greater than zero, indicating that suspended load increases were not disproportionately large in larger watersheds.

Turbidity samples provide estimates of suspended sediment at a location on a stream. However, detecting changes in sediment loads is even more difficult than for peak flows, because sediment loads are more variable and more costly to measure (Lewis et al. 2001), even though sediment load estimates have benefited from improved sampling technology. Still, Lewis et al. (2001) found in the cross-validation of models for runoff peaks, volumes and sediment loads, "the sediment models are not likely to predict future sediment loads well, and the associations identified between sediment loads and the disturbance variable in the models may be coincidental."

Channel geomorphology influences suspended sediment load transport and storage. Lewis et al. (2001) found that while the mathematical approach indicates the combined effect of multiple disturbances on sediment loads is additive (increases no greater than would be expected from the proportion of area disturbed), the mainstem stations were all within 25 percent of the sum of the loads predicted for undisturbed watersheds, indicating that the sediment from the tributaries was deposited prior to reaching the downstream gages. Hence Lewis et al. (2001) concluded that sediment loads are affected as much by channel conditions (e.g. organic debris, sediment storage sites, channel gradient, width-to-depth ratios) as by sediment delivery from the hillslopes. Similarly, Koehler et al. (2001) states that increases in suspended sediment loads from sediments trapped in long-term channel storage sites (10 to 100 or more years), and transported downstream during high flow events, have the potential to create an overestimation of the sediment generated by contemporary upslope management practices.

Nonetheless, the most important explanatory variable in the aggregate analysis of the North Fork Caspar Creek sediment loads was increased stormflow (Lewis et al. 2001). As peakflow increases are greatest for the smallest peaks occurring during the driest antecedent conditions, Lewis et al. (2001) found most of the larger percentage increases in clearcuts were from small events and equated to relatively minor absolute increases in load. Median percentage increases were greater in clearcut watersheds than in partially cut watersheds. As the sediment load increases in North Fork tributaries were related to increased storm flow volumes, as the peakflow increases diminish with vegetation growth, flow related increases in sediment load are expected to be short lived. Lewis also felt that sediment increases in the tributaries probably could have been reduced by avoiding activities that denude or reshape the banks of small drainage channels.

The South Fork had road construction beginning in 1967 with 6.8 km road build within 61 m (200 ft) of the stream. Between 1971 and 1973, single tree and small group selection silviculture was used with ground-lead tractor logging for the entire SF watershed. Approximately 65 percent of the timber volume was removed. (Henry 1998). The North Fork was harvested between 1985 and 1992, clearcutting approximately 50 percent of the watershed, primarily with cable yarding systems.

Suspended sediment concentrations (SSC) have been measured in the North and South Forks weirs of Caspar Creek since water year 1963. Turbidity is related to SSC, but to a lesser percent (e.g. for the 1998 data, the relation of turbidity (T) to SSC was $T = 1.89 \times SSC^{0.49}$ (Lewis 2000)). The table below shows the turbidity frequency of these two (paired) watersheds between 1996 to 1999 (Lewis 2000).

TABLE 11C
TURBIDITY FREQUENCY. TURBIDITY EXPRESSED IN # DAYS EXCEEDED (1996-1999)

Turbidity (NTU)	NF96	SF96	NF97	SF97	NF98	SF98	NF99	SF99
40	7.90	4.56	12.69	12.97	32.12	33.58	14.76	25.88
60	2.77	1.98	8.24	6.49	12.94	20.05	6.79	10.94
80	1.12	1.22	6.98	4.22	6.99	13.02	3.07	7.05
100	0.84	0.62	5.80	3.35	4.69	9.21	1.51	5.14
150	0.40	0.31	2.07	2.17	1.97	5.06	0.69	2.87
200	0.25	0.17	1.51	1.47	0.85	2.94	0.49	1.70
250	0.10	0.03	0.97	0.77	0.38	1.85	0.36	1.10
300	0.08	0.00	0.76	0.48	0.19	1.28	0.28	0.91
400	0.05	0.00	0.61	0.25	0.15	0.72	0.22	0.53
500	0.02	0.00	0.56	0.19	0.11	0.44	0.15	0.42

In general, the North Fork had higher turbidity than the South Fork only in 1996 and 1997. Due to the El Nino water year in 1998, record precipitation (during the life of the Caspar Creek study) increased the suspended sediment in both Forks of Caspar Creek, and generated numerous landslides related to the old road network in the South Fork watershed (Cafferata and Spittler 1998). Additionally, several miles of road abandonment work was conducted the South Fork in the summer of 1998, which is also likely to have contributed to the rise in turbidity. Much of the turbidity increase seen in the North Fork can be attributed to a large landslide located in a tributary just above the North Fork weir (Lewis 2000).

Data from the Caspar Creek watershed study shows that over the 1996 to 1999 hydrologic years , the North and South Forks have averaged 17 and 19 days over 40 NTUs each year, respectively (Lewis 2000). Turbidity levels exceeded 100 NTUs in the North and South Forks approximately 3 and 5 days, respectively, each year. It is likely that several of the planning watersheds in the western portion of JDSF have generally similar numbers of days with elevated turbidity levels.

Other landscape variables, which could eventually deliver eroded material to streams (thereby becoming sediment), include landslides and roads. Furbish and Rice (1983) found that inner gorges, approximately 30 percent of the study area, contributed 88 percent of the landslide volume; and outside the inner gorges, 85 percent of the slide volume was associated with roads. Table 11D briefly summarizes the suspended sediment and sediment producing variables mentioned above as they pertain to each alternative.

TABLE 11D QUALITATIVE SEDIMENT LOAD COMPARISON OF ALTERNATIVES					
Alternative	**A** **No Harvest**	**B** **1984 Mgt. Plan**	**C** **Draft Mgt. Plan**	**D** **Citizens Adv. Comm.**	**E** **Late Seral Emphasis**
Peakflow projections (Table 11B)	0 %	9.6 %	6.8 %	3.4 %	1.7 %
Silviculture	N/A	Similar to C, but no allocation plan	Silviculture allocation plan: ⅔ unevenaged, ⅓ evenaged	All unevenaged management	All unevenaged management
Primary streamside protections	N/A	Forest Practice Rule (FPR) Protections	FPRs plus no fire ignition within channel zones; LWD retention	FEMAT	Same as D
Roads	Primarily maintenance oriented	Project by project repairs	Road Management Plan	Road Management Plan	Road abandonment emphasis
Geologic Review	N/A	Review as per FPRs	FPRs and Certified Engineering Geologist review of unstable areas	Same as C with no operations within inner gorges	Same as D
Special Concern Areas (SCAs)	N/A	Similar to C, but not including inner gorge or landslide SCAs	23 SCAs including inner gorge or landslides with no harvest or harvest restrictions	Similar to C with expanded riparian zones and habitat development	More no-harvest restrictions than C
Sediment Load Assessment	*Influenced primarily by legacy road impacts*	*Affords current protections and few reductions above status quo*	*Affords current protections with some measures to reduce current levels*	*More aggressive than C in efforts to reduce current sediment levels*	*Same as D*

As the peakflow increases are anticipated to be relatively benign, the short-lived suspended sediment increases associated with peakflows are similarly anticipated to be relatively benign. Of greater consideration are the silviculture and channel protection measures that have been shown to influence suspended sediment loads, and the road and landslide measures that have been shown to increase sediment inputs. Correspondingly, suspended sediment loads increase in clearcuts, in channels without buffers, and in small drainages that are burned and/or reshaped. Sediment delivery from landslides and road failures increase when failures are in close proximity to a watercourse (common along steep inner gorge settings, where roads are located adjacent and parallel to a stream, on improperly constructed roads and legacy roads, at road crossings, and roads with inadequate maintenance).

TABLE 11E
EQUIVALENT CANOPY REMOVED / EQUIVALENT CLEARCUT ACRES (ECA)

Silviculture:	ALPR	CLCT	CMTH	CSLC	DL22	GSLC	SASV	SHPC	SHRC	SHSC	SLCN	STRT	STSC	TRAN			
% canopy loss for method	50%	100%	50%	50%	75%	25%	50%	75%	25%	75%	50%	25%	75%	50%			Proportion of Canopy Removed from JDSF:
Year	Acres														Total Acres	ECA	
1980					624										624	468	0.00962
1981		12	238		295						242				787	473	0.00972
1982		2	252		1,125										1,378	971	0.01996
1983		66	144		1,383						278				1,871	1,314	0.02701
1984		169				262					12				442	240	0.00493
1985		124			550						46				720	560	0.01151
1986		378				41			405		275			163	1,263	709	0.01457
1987		294									29			48	372	333	0.00684
1988		456	64							46	314				880	680	0.01398
1989		277	65						346				52		740	435	0.00894
Total 80s Acres:	0	1,778	763	0	3,977	303	0	0	751	46	1,196	0	52	210	9,076	**6,182**	
1990		54								219				367	640	402	0.00826
1991	720	125	10					96						314	1,265	719	0.01478
1992	22	11	219			62					453		35		801	399	0.00820
1993	26	70									340	30			465	260	0.00534
1994			575			110	22				286				994	469	0.00964
1995			1,718								441	375	192		2,726	1,317	0.02707
1996		39	6	85		305					1,974				2,408	1,147	0.02358
1997	113					21					716	124			973	450	0.00925
1998						67					501				568	267	0.00549
1999	135		158								1,352				1,645	823	0.01692
Total 90s Acres:	1,015	298	2,687	85	0	565	22	96	0	219	6,062	529	227	681	12,485	**6,254**	

TABLE 11 F
ECA ACRES PER YEAR PER PLANNING WATERSHED DIVIDED BY THE TOTAL PLANNING WATERSHED ACRES

YEAR	WATERSHED/PLANNING WATERSHED ACRES											
	Berry Gulch 7,999	Brandon Gulch 6,449	Caspar Creek 5,360	Chamberlain Creek 7,868	Hare Creek 6,184	James Creek 4,459	Kass Creek 3,533	Mouth of Big River 9,548	Lower NF Big Rv. 4,953	Mitchell Creek 6,554	Parlin Creek 7,578	Upper NF Big Rv. 5,420
1980						10.50%						
1981					4.07%	4.96%						
1982				8.24%	2.06%	4.38%						
1983					2.23%	6.09%		1.46%				14.13%
1984			2.79%							1.00%	0.33%	
1985		3.71%		2.40%	1.84%		0.49%					
1986	1.57%		6.38%				6.83%					
1987	2.00%										2.28%	
1988			2.98%		4.58%						3.12%	
1989	0.03%		3.35%				3.09%				1.90%	
1990	2.73%	2.84%										
1991	1.01%		2.42%		2.91%				2.29%		2.84%	
1992					3.91%						2.07%	
1993	1.36%	1.26%					1.99%					
1994			3.18%								3.94%	
1995	3.01%		2.01%		3.13%		0.45%				10.03%	
1996		5.05%			5.74%		9.34%	1.43%				
1997		4.52%			0.50%						1.69%	
1998		2.59%									1.32%	
1999		5.75%			4.93%					0.38%	1.61%	